Fauna of India

REPTILIA

Testudines and Crocodilians

Volume : I

R. C. SHARMA

This book forms Volume one of the *Fauna of India, Reptilia* and covers the Indian Region. It deals first with the general introduction which includes a brief history of the progress in the reptile-taxonomy, brief characters, phylogeny, geographical distribution, zoogeography, historical review and classification used, etc. Also included are the descriptions of characters and the systematic accounts of 23 genera, 51 species and subspecies of Testudines and two genera and three species of Crocodilians.

THE FAUNA OF INDIA AND THE ADJACENT COUNTRIES

REPTILIA

VOLUME I

(Testudines and Crocodilians)

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Zoological Survey of India, Jodhpur

Edited by

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FOREWORD

The beginning of herpetological studies in the Indian region dates back to mid-nineteenth century, when Gunther (1864) published the *'Reptilia of British India'* Thereafter the knowledge upto first quarter of the present century was consolidated in detail by Malcolm Smith (1931-1944) in three volumes of *'Fauna of British India'* Since then, there has been a considerable increase in the knowledge of taxonomy, distribution, biology and ecology of reptiles and therefore, a need arose to update the earlier documents. The task of this revision has been undertaken by Dr. R. C. Sharma, who successfully completed this volume on *'Crocodylia and Testudines'*, which is the first in the series of three volumes.

Testudines, which include tortoises and turtles, are mainly aquatic (both marine and freshwater) but some have also adapted to the terrestrial mode of life. They play a very significant role in the conservation of ecosystem. Several species of turtles are now endangered or vulnerable because of their overexploitation. Similarly, the crocodiles have also been exploited for their skin, so that their population has dwindled drastically throughout the country, placing all the existing forms in the list of endangered species.

The present volume deals with two genera and three species of Crocodylia and 23 genera and 51 species/subspecies of Testudines. Besides detailed taxonomic treatment of various species, notes on phylogeny, distribution and zoogeography of reptiles have also been incorporated.

It is expected that this document will be of immense use to both, the taxonomists and wildlife workers alike. The baseline information will also be helpful in formulating proper conservation strategies for their protection.

Calcutta
March, 1998

J. R. B. Alfred
Director
Zoological Survey of India

AUTHOR'S PREFACE

Since the publication of Malcom Smith's "The Fauna of British India-Reptilia and Amphibia", in 3 Volumes (1931-1943), the taxonomic research and related knowledge in the subject has increased considerably. This warrants updating of the reptile fauna, of the Indian Region. The work will be complete in three Volumes. The present volume is the first in the series which deals with general introduction of class reptilia, covering briefly all the possible details and descriptions of the characters and the systematic accounts of 23 genera and 43 species (51 species and subspecies) of Testudines, and 2 genera and 3 species of Crocodilians. This faunal work, apart from providing an up-to-date and complete taxonomic account of all the species and subspecies known from the Indian Region, also provides sufficient information on biology, ecology, distribution, zoogeography, habits and habitats, status, conservation and captive breeding of a number of species. I hope this book will serve as an important tool to specialists, research students and naturalists in India and abroad interested in the fascinating study of colourful Indian Testudines and Crocodilians.

R. C. Sharma

ACKNOWLEDGEMENTS

I express my deep sense of gratitude to Dr. J. R. B. Alfred, the Director, Zoological Survey of India for help in various ways and encouragement during the entire course of this work. I am also greatly indebted to Ex-Directors, ZSI, Prof. M.S. Jairajpuri and Dr. A.K. Ghosh for their valuable advices & help. The suggestion given by my brother Umesh Chandra Sharma in connection with basic pattern and arrangements of this book and to my son Arun Sharma for his help in preparation of several illustrations is also acknowledged.

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Last but not the least I am highly obliged to the late Professor M.L. Roonwal, former Director, Zoological Survey of India, for kindly going through the manuscript and for giving valuable suggestions in preparation of the manuscript. I am also indebted to Dr. Ishwar Prakash, Professor of Eminence, Central Arid Zone Research Institute, Jodhpur, for useful suggestions from time to time.

R. C. Sharma

ABBREVIATIONS

AB.—	Abdominal shield of plastron;
AFBOC.—	Articular facet for basioceipital;
AFEXO.—	Articular facet for exoceipital;
AFO.—	Articular facet for quadrate;
AN.—	Anal shield or angular bone of mandible;
API.—	Acetabular part of illium;
APIS.—	Acetabular part of ischium;
APP.—	Acetabular part of pubis;
ARI.—	Articular facet of illium;
AROP.—	Articular process for odontoid process;
ART or ar..—	Articular bone of mandible;
AT.—	Atlas vertebra;
AX.—	Axillary shield of plastron or axis vertebra;
BF.—	Basipital fossa;
BOC. or bo.—	Basioccipital;
BSPH. or BP. or bp.—	Basisphenoid;
BRAR.—	Branchial cornua of Hyoid;
BRIT. Mus.—	British Museum of Natural History;
CA. or ca.—	Columella auris; Canine teeth;
CART.—	Cartilage between quadrate and paraoceipital process;
CB.—	Chevron bone;
CBOC.—	Part of Occipital Condyl formed by basioecipital;
CC.—	Concavity;
CD.—	Coracoid;
CDF.—	Coracoid foramen;
CEXO.—	Part of occipital condyl formed by exoccipital;
CFI.—	Condyl for fibula;
CJ.—	Cartilaginous joint;
CL.—	Claw or claws or Clavicle bone;
CO. or CR. or Cor.—	Coronoid bone of mandible;
CP.—	Clawed distal phalanges or Corpus hyodium of Hyoid;
CO.—	Cranio-quadrate passage;
CR1.—	First cervical rib;
CR2.—	Second cervical rib;
CT.—	Centrale;
CTI.—	Condyl for tibia;
D. or d.—	Dentary;

DC_1.—	First distal carpal;
DC_5.—	Fifth distal carpal;
DR.—	Deltoid ridge;
DT.—	Distal tarsal;
EAP.—	Extra acetabular portion of ilium;
ECD.—	Epicoracoid;
ECTPT.—	Ectopterygoid;
EN.—	Entoplastron;
EPB.—	Epipubis;
EPS.—	Episternum;
EPT.—	Epipterygoid;
ESTS.—	Extra stapes;
EXO, or EO.—	Exoccipital;
EXOPR.—	Paroccipital process;
EP.—	Epiplastron;
F or FR. or f.—	Frontal
FE.—	Femoral shield of plastron or femur bone;
FI.—	Fibula;
FIB.—	Fibulare;
FM.—	Foramen magnum;
FMCK.—	Fossa meekelii;
FME.—	External mandibular fossa;
FOR.—	Foramen rotundas;
FOV.—	Part of foramen ovalis;
FPT.—	Post temporal fossa;
FV.—	Foramen;
GU.—	Gular shield of plastron;
HH.—	Hyo-hypoplastron;
HO.—	Hyoplastron;
HP.—	Hypocentrum;
HU.—	Humeral shield of plastron or humerus bone;
HY.—	Hypoplastron or hyoid cornua of Hyoid;
IF.—	Inframarginals;
IG.—	Intergular shield;
IM.—	Intermedium;
IN.—	Inguinal shield of plastron;
IP.—	Interparietal;
IPT.—	Interpterygoid space;
ITF.—	Infratemporal fossa;
ITR.—	Internal trochanter;
J.—	Jugal;
LAC.—	Lachrymal;
L.G.—	Ligament;
lOC.—	Locality;
MX. or m.—	Maxillary or maxilla or maxillae;

M.A.— Marginal shields of carapace;
MC.— Metacarpal;
MCK.— Meekel's cartilage;
N.— Nasal bone;
NC.— Neural canal;
NCA.— Nasal capsule;
N.S.— Neural spine;
NU.— Nuchal shield of carapace;
OC.— Occipital condyl;
OF.— Obturator foramen;
OP.— Odontoid process;
OPR.— Olecranon process;
OPO.— Opisthotic;
ORSPH.— Orbitosphenoid;
P. or p.— Parietal;
PAF.— Palatine foramen;
PL. or PAL.— Palatine;
PAP.— Preacetabular process of ilium;
PBSPH.— Pterygoid process of basisphenoid;
PE.— Pectoral shield of plastron;
PEC. AR.— Pectoral arch;
PEG.— Process entoglossus of Hyoid;
PF.— Prefrontal bone or parietal foramen;
PFR.— Prefrontal bone;
PLF.— Palatal fossa;
PLPT.— Pterygoidal bulla;
PMX. or pm.— Premaxillary or Premaxille;
POF.— Postfrontal;
POR.— Postorbital;
PPO.— Paroccipital process;
PPT.— Palatine process of pterygoid;
PN.— Prenuchal shield of carapace;
PRF.— Prefrontal;
PRO. or pro.— Prootic bone;
PSARTP.— Postarticular process;
PSPM.— Parasphenoid;
PT. or pt.— Pterygoid bone;
PTF.— Posttemporal fossa;
PTF.— Postorbital;
PVO.— Prevomer;
PZS.— Postzygapophysis;
PZT.— Postzygapophysis;
QD. or q.— Quadrate bone;
QPT.— Quadrate process of pterygoid;
QJ.— Quadrato-jugal;

R.— Radius bone;
RD.— Radiale bone;
ROE.— Recessus oticus externus;
S.— Sternum;
SAN. or s. ang.— Supra-angular;
SO. or Soc. or so.— Supraoccipital;
SP.— Scapula;
SPL.— Splenial;
SQ. or sq.— Squamosal;
SS.— Suprascapula;
ST.— Supratemporal;
STF.— Supratemporal fossa;
STP.— Supratemporal process of parietal;
STS.— Stapes bone;
SU.— Supracaudal shield of carapace;
T.— Teeth;
TI.— Tibia bone;
TP.— Transverse process;
TYP.— Tympanic process;
U.— Ulna bone;
UC.— Ulnar Condyl,
UN.— Ulnare;
Vo. or v.— Vomer;
VE.— Vertebral shield of carapace;
VP.— Ventral process;
VR.— Vertebral rib;
XI.— Xiphiplastron;

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INTRODUCTION

Considerable time has been elapsed since the publication of Malcolm Smith's work on the Reptiles of India and adjoining countries (1931-1943—The Fauna of *British India, Ceylon and Burma*, including the whole of Indo-Chinese sub-region in 3 Volumes. Now it has become absolutely essential to update the Fauna of India on Reptiles once again in order to bring out current taxonomic arrangement of the species by involving a critical appraisal of relevant data in accordance with the advancement in reptile taxonomy during the recent times. The considerable increase in the number of species and our related knowledge in the field of Herpetology pertaining to his vast region for the last 60 years, invites attention for a fresh treatment to the faunal work on the reptiles. This work includes all the species inhabiting the Republic of India, Bangladesh, Bhutan, Burma, Nepal, Sri Lanka and Pakistan.

The entire Class Reptilia has been dealt in three volumes. This vol. 1 on Crocodilia and Testudines deals all the three species of Crocodiles and 43 species of Testudines. Therefore redescribed in the light of recent advances in the knowledge of Natural History (Habitat, Dirnal and Nocturnal cycles. Aggression and defensive behaviour, Reproduction) and Taxonomy, Numerous changes have taken place in the taxonomy of turtles and tortoises; plenty of knowledge has been accumulated relating to their distribution, natural history and biology. Revised descriptions are much required for numerous species and sub-species belonging to the various Testutdine genera like *Chelonia, Lepidochelys, Dermochelys, Eretmochelys, Platysternum, Geochelone, Trionyx* and *Lissemys.*

Besides the enormous identified reptile material, available in Zoological Survey of India, Calcutta were examined in all the possible deatails. At may occasions the reptile material (including the types) was borrowed from other institutions for study and comparison. Numerous faunistic surveys were conducted by the Zoological Survey of India in different parts of India during the last 60 years after the publication of Smith's fauna of reptiles. These extensive surveys further initiated the detailed studies on the reptiles of the area covered in this work. Type localities were studied once again, topotypes of various species were collected and related ecological and biological observations were recorded on the various less known species.

In this work general norms of systematics have been followed and the law of priority has been strictly maintained while describing a taxa. Trivial names have been used only for the well established taxa. Vernacular names have been used for those species which are most common and known thoroughly in a large area. The complete synonymy has been given for each species as far as possible.

Malcolm Smith (1931-1943) made enormous contribution in the growth of knowledge of herpetology mainly concerning the Indian and Indo-chinese subregions. He was an amazingly prolific writer and possessed the deep knowledge of the subject. His main work comprises the studies of the 742 species of crocodilians, testudines, lizards and snakes distributed in three volumes entitled as, "The Fauna of British India Ceylon and Burma" Smith's earlier work was deeply influence by Boulenger, but he soon developed various other interests, especially in the Zoogeography, structure and life-history of amphibians and reptiles.

During the recent years various outstanding contributions added the knowledge to the various branches of herpetology such as the series of hand books, on chelonians by Archie Carr (1942) on the reptiles of Ceylon by Deraniyagala (1930-1953); Minton (1956) has given a most elaborate and useful contribution to the knowledge concerning the reptiles of west Pakistan.

Progress of work in India and adjoining countries

The beginning of studies of herpetology in Indian Subregion dates back as early as middle of nineteenth century and the first consolidated work was published by Dr. A. Gunther (1864) in the year 1864. "The Reptiles of British India" The various Indian and Indo-chinese herpetologists, who made outstanding contributions in the various fields are Theobald (1876) (Descriptive catalogue of the reptiles of British India); Boulenger (1882-1920); The Fauna of British India Reptilia and Batrachia; Russell Patrick (1796-1809) (An account of Indian serpents collected on the coast of coromandal and other parts of India); Hardwicke (1756-1835) (Drawings of reptiles and amphibians); Hamilton, Francis, (1762-1829) (Sketches of reptiles); Reeves, (1774-1856) (Sketches of Chinese reptiles); Hodgson (1800-1894) (Sketches of reptiles and amphibians); Cantor Thomas Edward (1836-1847) (Catalogue of reptiles inhabiting the Malayan Peninsula and Islands); Blyth, E. (1853-1855) (Descriptions on various Indian reptiles); Jerdon Thomas (1853) (Catalogue of reptiles inhabiting southern India); Blanford W.S. (1870-1879) (Notes on some reptilia and amphibia from central India, Notes on a collection of reptiles and frogs from the neighbourhood of Ellore and Dumaguden); Fayrer J. (1874) (Thantophidia of India); Theobald, W. (1868-1876) (Catalogue of reptiles in the museum of the Asiatic society of Bengal, Descriptive Catalogue of reptiles of British India); Beddome, R.H. (1862-1886) (Numerous papers on the snakes and lizards of Peninsular India); Anderson J. (1871-1879) (Notes on various Indian Testudines; Anatomical and Zoological researches and Zoological results of the Yunnan expeditiens on reptilia and amphibia, on some Indian reptiles; on some Persian, Himalayan and other reptiles; a list of the reptilian accessions to the Indian Museum, Calcutta); Stoliczka, P. (1864-1873) (Fifteen papers on reptiles and amphibians of India, Malaya, Burma, Sind, Andaman and Nicobar Islands); Ferguson, M. (1891-1903) (Distribution of Indian crocodile; a new tortoise from Travancore; Travancore snakes; Kelaart, E.F (1852) (Prodromus Faunae Zeylanicae; contributions to the Zoology of Ceylon); Sclater, W.L. (1891). (List of snakes in the Indian Museum, Calcutta; Notes on a collection of snakes in the Indian Museum with description of several new species); Annandale N (1906-1921) (Numerous papers on herpetology of India, Nepal, Ceylon, Western Himalayas, Burma, Borneo, Andamans and Nicobar Islands); Flower, S. (1899) (Notes on the reptiles of Malaya Peninsula and Siam); Wall F. (1897- 1926) (Numerous papers on the snakes of the complete Indian subregion) and Smith, M.A. (1931-1943) (The Fauna of British India including Ceylon and Burma, in three volumes Loricata & Testudines, Sauria and Serpentes and Mahendra, B.C. (1983) (Hand book of the snakes of India, Ceylon, Burma, Bangladesh and Pakistan. In addition to the above works some of the following researches on the regional reptiles are worth recognition also.

Anderson S.C. and Leviton A.E. (1966); published a review of the Ophiomorus with descriptions of three new species; Anderson, J.A. (1963-64) published papers on

Terato lepis fasciata (Biyth) and on the reptiles of Thar Pakar desert of Pakistan; Biswas, S. and Sanyal D.P. (1965-1990) published many papers on Indian reptiles; Constable, J.U. (1949) published a good paper on the reptiles of Indian Peninsula; Daniel, J.C. (1983) published a good on Indian reptiles; Deoras, P.J. (1965) published a book on the snakes of India; Deraniyagala, P.E.P. 1960-61) published the account of reptiles of Sri Lanka; Gharpurey, K.G. (1954) written a book on the snakes of India; Gradison, A.G.C. and Soman P.W. (1963) published the account of a new species of lizard Hemidactylus albofasciatus; Hora, S.L. (1924-1949) published many papers on Indian reptiles; Inger, R.F and Clark P.J. (1983) published a paper on genus Coluber; Krishna, D and Dave, K.C. (1954) published a paper on the reptiles of Rajasthan; Mathur P.N., Kashyap, K.V., Prakash R. and Bhatnagar, S.P. (1954-1961) published remarkable work on the comparative anatomy of the reptilian heart; Majupuria (1961) published many good papers on the myology, excreatory system, reproduction and cytology of various reptiles; Mertens, R. (1954-1959) published many papers on reptiles of Pakistan. Minton S.A. (1966) published a detailed account on the reptiles of Pakistan; Murthy, T.S.N. (1972-1990) published many papers on the Indian reptiles; Sharma, R.C. (1969- 1993) published many papers on Indian reptiles; Shrivastava, R.K. Satsangi, P.P. and Tilak, R. (1964) published quite a number of papers on the scalation and osteology of the Indian reptiles, Stickel, W.H. (1951) published a very good paper showing the distinction between the snake genera Contia and Eirenis; Swan, L.W. and Leviton, A.E. (1962) published a very good paper on the herpetofauna of Nepal; Tiwari, K.M. and Biswas, S. (1973) published a paper on the reptiles of Great Nicobar Islands; Tikader, B.K. and Sharma, R.C. (1985), published a "Hand book on Indian Testudines" and Tiwari, K.K. and Sharma, R.C. 1970), published a paper on the reptiles of western Maharashtra.

PHYLOGENY

The most primitive and ancient cotylosaurian reptiles which are also called as the 'stem reptiles' originated about 300 millions years ago in the upper carboniferous period from a group of Stegocephalian amphibians which are placed in a family Solenodonsauridae of Order Anthracosauria of class Amphibia. All these amphibians, ancestral to the reptiles had most primitive characters like, 1. Presence of the complete set of dermal bones in the skull roof, palate and mandible, 2. Skull was high and narrow, with only one occipital condyl, otic notches were deep, basipterygoid articulation was movable, interpterygoid fenestra was small and brain case was fully ossified as one compact unit, 3. In parietal region an intr temporal bone was also present along with a supratemporal, 4. There was a separate epipterygoid in the palate-guadrate arch, 5. The vertebrae were embolomerous in which the hypocentra and pleurocentra were equally developed and cover the notochord as a complete ring. This ancient group of amphibians is also called as Labyrinthodontia on account of the recurved dentine of their teeth.

These parental cotylosaurian reptiles form the main stem from which the branches of all other reptiles have evolved gradually during the course of time. Crocodilians are the most primitive creatures and originated from a stock of reptiles grouped together under the order Thecodontia of subclass Archosauria of class Reptilia

(Romer 1933-1966), in the late Triassic, say about 200 million years ago. About 150 million years ago, before the beginning of the Jurassic, the crocodiles became well established and flourished nicely at the end of Mesozoic period. The connecting link between the ancestral Thecodonts and much evolved crocodilians was a one metre long, lizrd-like crocodile called as *Protosuchus* from the upper Triassic period (190 million years ago). Crocodilians exhibited remarkable diversity during the Jurassic period, when their various forms came to the existence and evolved to the maximum perfection. Some of those crocodiles had very long snouts like gavialis and were highly adapted for a pissivorous way of life. Few of them were dwarfs, not exceeded even 30 cm. in length and had short wide jaws. Few crocodilians of family Metriorhynchidae adopted the marine way of life but completely died out up to the lower cretaceous period, possibly on account of the Icthyopterygians (fish like swimming sea reptiles), who were proved as better competitors for food in the sea. A large crocodile, *Phobosuchus* from the upper creataceous, say about 80 million years, ago, reached up to 45 feet in length and was a strong predator on herbivorous dinosaurs. A massive gharial, *Ramphosuchus*, measuring up to 50 feet in length lived in India during the Pliocene, roughly about 13 million years ago.

The modern chelonians have maintained numerous characters of their ancestors which flourished in the Permian epoch. This ancient group of reptiles has no close relationship to the orders of recent or extinct reptiles and as such there is a deep mystery regarding their origin and relationship. From Triassic period to this date turtles have hardly undergone any changes. Their maximum development took place from late Mesozoic to early Tertiary period. The main divisions of chelonians which occurred in those early days are still existing to-day. But there has been a considerable reduction in the number of their families and genera. For many years a small fossil reptile, *Eunotosaurus africanus*, from the Middle Permian of South Africa was regarded as the connecting link between the cotylosaurs and the turtles on the basis of its broadened body and eight pairs of expanded ribs. But the fossil remains of *Eunotosaurus* did not reveal the presence of plastron, abdominal ribs, hard dermal covering and other such features suggesting relationship with the turtles and their allies. Moreover, certain most important parts like skull roof, neck and the limbs have not been discovered so far in the fossil remains of *Eunotosaurus*. The expanded ribs of *Eunotosaurus* are leaf-shaped and are not the homologous to the pleural bones of true turtles. The earliest fossil Testudines of family Proganochelyidae, are from the Triasic of Germany. The closely allied *Triassochelys dux* and *Proganochelys quenstedi* contained primitive features like teeth in both the jaws and palate, numerous marginals and supramarginals, four pairs of costal scutes and five vertebral shields. The exact mode of evolution of Proganochelyidae from the primitive step reptiles is still unknown as fossils of the connective missing links have not been discovered so far. There are enough evidences that the ancient Proganochelyd turtles were marsh-dwellers and the modern turtles have evolved independently in the early Permian. Turtles neither evolved from any group which has already developed a lateral or dorsal temporal fossa in the skull nor can they be evolved from any form in which the palate was fused with the other bones of the cranium. Many factors indicate that recent turtles have not evolved even from the primitive reptiles like Didactomorph cotylosaurians which were at the peak of development and vigorously flourished from

the Carboniferous to the Triassic period. These reptiles exhibit a marked resemblance to turtles by having a perfect and complete roofing of the skull and well-defined otic notch. On the other hand, the Didactomorphs had the palate firmly fused to the braincase. This indicates that the chelonians had already assumed an independent evolutionary chennel and become separate by the time this marked change crept in the anapsid skull of the cotylosaurs. The exact ancestory of the modern terrestrial and aquatic testudines goes back to the Upper Cretaceous period. The fossil *Zangerlia testudinimorpha*, a large amphibious turtle from the lower Numegt beds of Mongolia had a deep shell, very strong dorsal sulci, thick sculptured scutes, shortened phalanges and the extensive fusion of the carpal elements. All these characters present in *Z. testudinimorpha* are also available iin most of the tortoises of the present times. The freshwater adaptations exhibited by this ancestral turtle are the presence of features like a straight humerus, slightly reduced plastron and the elaborate superficial sculpturing of the shell. It is evident that the fully aquatic preference of most of the present turtiles is most probably a secondary adaption. The shielded or scaled body covering, shelled eggs and habits of egg laying on the land indicate the change in their original tendencies of mud and water dwelling. They preferred a change and became gradually adapted to lead a life without fully depending on aquatic or marshy habitat. On the other hand, the broad, shell-encased heavy body makes many species helpless onland against strong predators, thus compelling them to move back to the freshwater medium. It was rather a forced protective adaptation during the early difficul times. This is the main reason why the majority of both recent and extinct turtles have or had a freshwater habitat. There are enough evidences that the terrestrial tortoises have evolved a lonlg back from the primitive emydid turtles. Fossil records of the primitive tortoises which are ancestral to the modern land tortoises are available from the Mid-Eocene deposits. Possibly they were present in the Paleocene and flourished in the Pliocene period. Evolutionary history of the modern marine turtles can be traced back to the early Triassic period. Fossil records of the marine turtles are available from the Lower Cretaceous, Upper Jurassic, and Upper Cretaceous. The exact phylogeny of the modern marine turtles of the families Cheloniidae and Dermochelyidae is yet to be established. It is quite interesting that certain modern emydid species show a strong preference for the estuarine life.

It can be concluded without any doubt that modern Testudiens emerged from the early cotylosaurs, although their ancestral fossil records have not been found in rocks before the Triassic period. It has been indicated that the Triassic turtles differ from their modern counterparts in minor respects only.

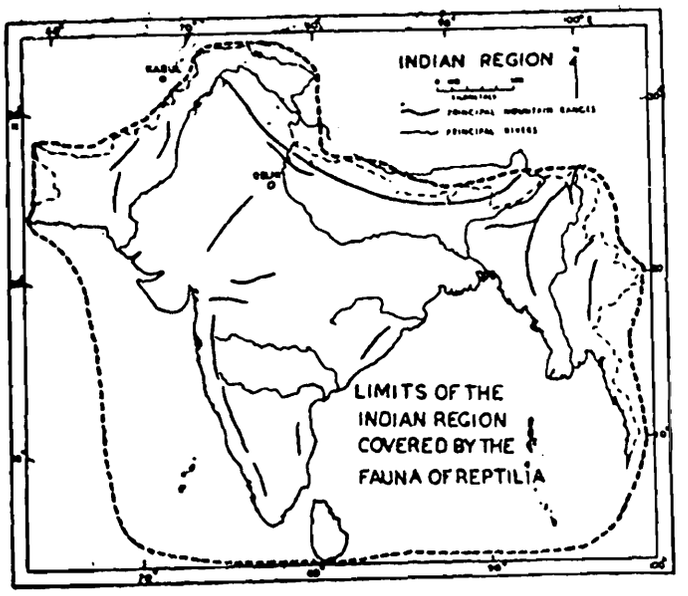
Climatic and physical changes in Indian sub-continent took place towards the end of cretaceous and made the vast areas quite unsuitable for the survival of many species of testudines. The formation of physical barriers such as mountain ranges, arid deserts, large sketches of water and dense forests caused the strict localization of numerous species which is continuing till the recent or present times. After passing through the numerous fluctuating conditions of temperature, rainfall, wind velocita, humidity, salinity, alkalinity and cooling process of the crust, the existing species of reptiles are now well adjusted in the different ecological nitches.

DISTRIBUTION AND ZOO GEOGRAPHY

The vast area of 5,149,530 sq. km. (6°S to 37°N and 61° to 101°E) covered in this faunal work on reptiles limits its scope within India, Pakistan, Nepal, Bhutan, Burma, Bangladesh and Sri Lanka. (Fig. 1)

From time to time various workers on zoogeography proposed certain faunal zones or divisions on the basis of topography and climate. Flower (1873) included India and Malayan-Peninsula into a single zoogeographical zone which he named as Indo-Malayan Region. He further divided this region into three more subregions, viz. the Himalayan or the Himalo-chinese subregion; the Indian subregion and the Malayan subregion, Wallace (1876) divided the Oriental Region in to i) Hindustan or the Indian subregion, which comprised the complete Indian Peninsula from Himalayan foot hills to the north of Goa; ii) Sri Lanka and other parts of South India; iii) The Himalayan or Indo-chinese subregion (Himalayan ranges up to 3000 metres), which included Kashmir in the west and Assam, Burma, Southern China, Thailand and Cochin-china in the east; iv) Indo-Malayan or the Malayan subregion, which included Malaya Peninsula and the Archipelago. Blanford (1888-1901) proposed five distinct zoogeographical subregions of India and adjoining countries *viz.* (Fig. 2) i) The cis-Gangetic subregion, ii) the Malabar Coast Tract and Ceylone Hill tract, iii) the Punjab tract, iv) trans Gangetic subregion and v) the Tibetan subregion. Smith (1931) was of the opinion that the reptilian fauna of sout-east Asia bears a close affinity with that of Assam, Burma, Eastern Himalaya and southern China and he regarded the whole region as a single faunistic zone. He constituted (Fig. 3) the three main subregions of the Oriental Region *viz.* 1) The Indian subregion, 2) Indo-chinese subregion and 3) the Malayan subregion. The Indian subregion was further subdivided by him in seven distinct natural faunistic zones, viz. i) The desert tract of the North-west including Baluchistan, North-west Frontier Provinces of Pakistan, the Punjab, western Rajasthan as far as Aravali ranges and Sind, ii) The Gangetic plain extending from Sind river to the right bank of Brahmaputra river, iii) Central India including the area between the Ganga plain, south Indian plateau, Aravali hills and Chota Nagpur, iv) Kashmir and western plateau between the twelfth and twentyfirst north parallels and a portion of the western Ghats, vi) Hilly areas of Malabar tract and Sri Lanka, vii) Chota-Nagpur tract including Bihar south of Ganga plain, north Orissa and east of Madhya Pradesh. The Indo-chinese subregion has also been divided in five areas viz. i) Eastern Himalaya and Assam tract extending from the western border of Nepal to the bend of the Brahmaputra river, ii) The trans-Himalayan mountains including the Upper Burma (low land of the southern Burma excluded), the hills of Assam east of the Brahmaputra, southern China, north Indo-china and northern portion of Thailand, iii) Annam (North Vietnam), iv) The Great plain of Indo-china; Burmese low land south of Prome and Toungoo; mouth of the Salween river; the plains of Thailand, Cambodia and Cochin-china, v) Tenasserim and Peninsular Thailand.

The present studies are based on the basis of the zoogeographical areas formed by the South. The affinity and interdispersal of all the species of reptiles inhabiting the South Asia, the area which is known zoogeographically as the Indian Region have been discussed thoroughly.



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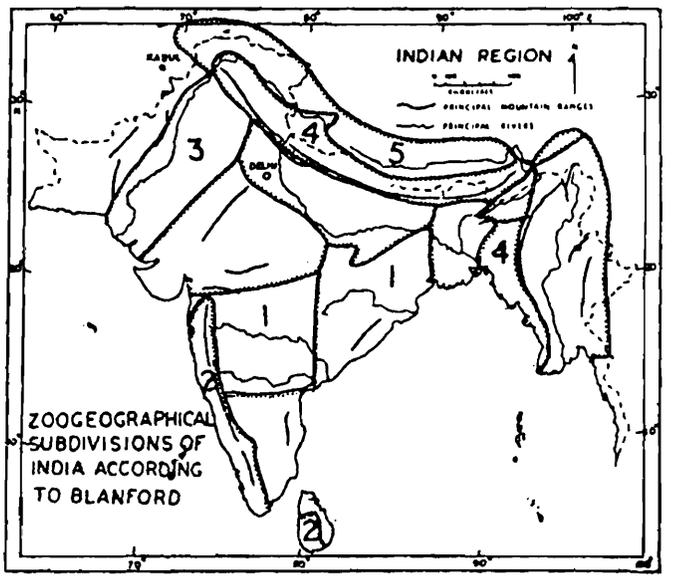

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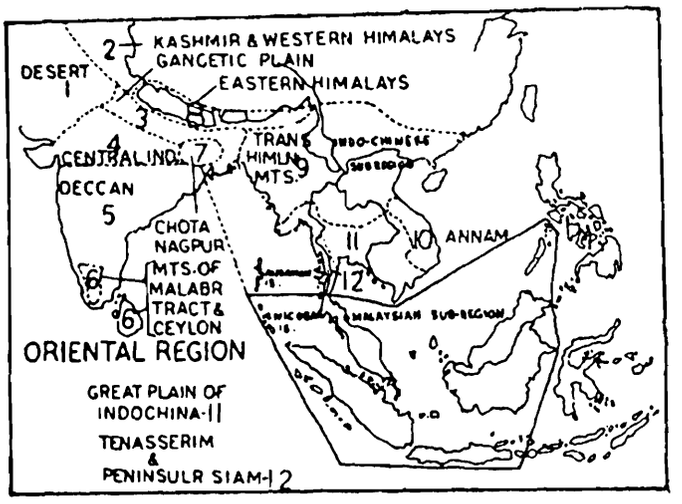

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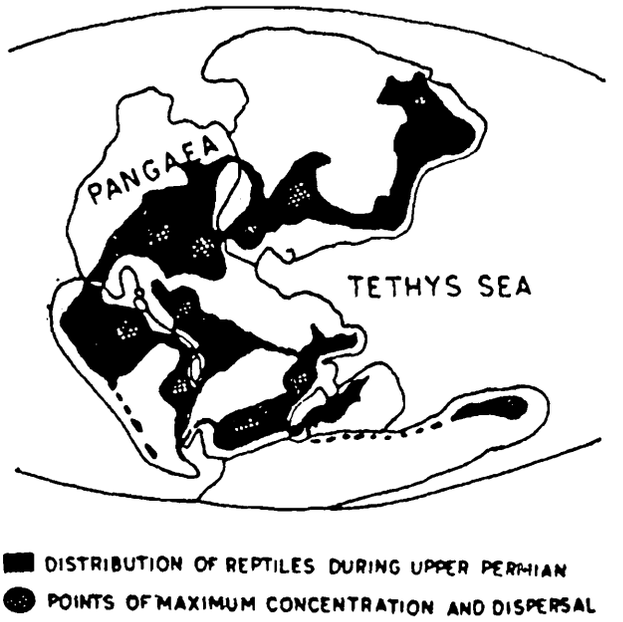

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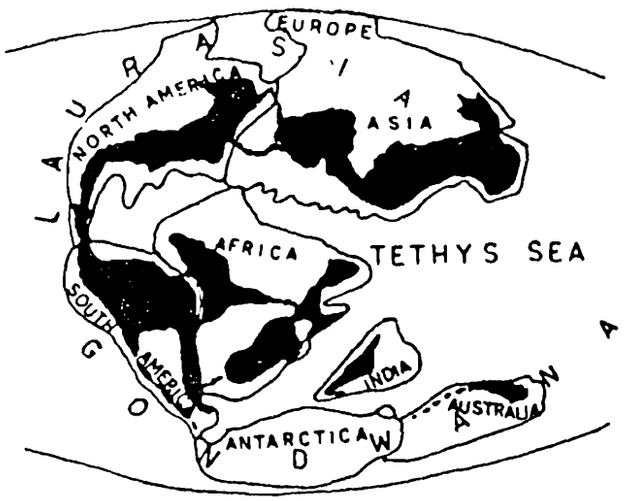
Fig.1. Limits of the region covered by the Fauna of Reptilia, in this volume.

Fig.2. Zoogeographical subdivisions of India and adjoining countries according to Blanford.

Fig.3. Oriental region.

Fig.4. Distribution of reptiles during upper permian
Points of maximum concentrution and dispersal.



DISTRIBUTION OF REPTILES DURING UPPER TRIASSIC

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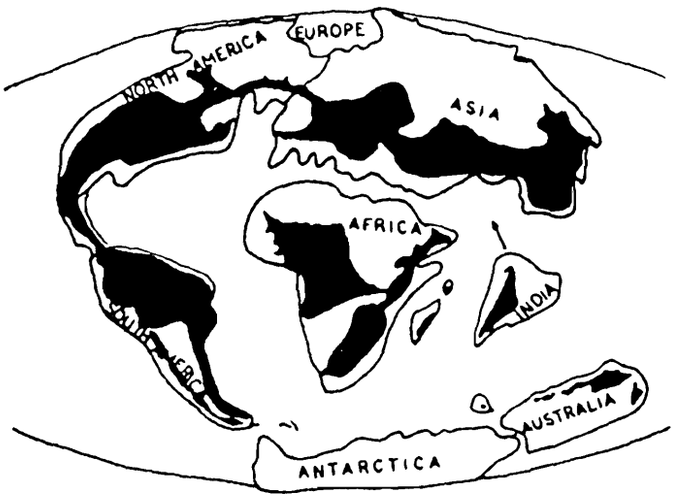

DISTRIBUTION OF REPTILES: UPPER CRETACEOUS

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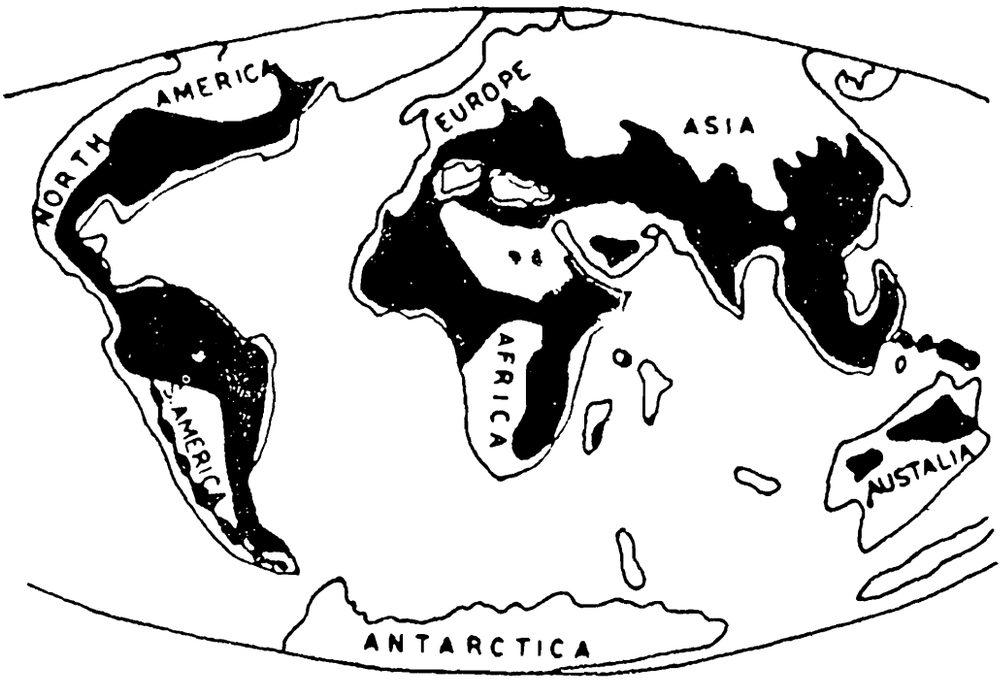

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Fig.5. Distribution of reptiles during Upper Triassic.
Fig.6. Distribution of reptiles : Upper Cretaceaus.
Fig.7. Distribution of reptiles during Coenozoic.

This is evident that 270 million years ago (upper carboniferous to upper cretaceous through the Permian period) of the whole world was in the form of a single landmass or "Pangaea" and the part of which subsequently has given rise to India was just lying at the middle of its L-shaped Africo-Australis portion (Fig. 4)

The vertebrates emerged, vigorously, evolved and multiplied both on land and in the sea during this period. Reptiles dominated the tetrapod fauna of complete Permian period, roughly 200 million years ago. Various groups of stem reptiles like Cotylosaurians; Chelonians, Lepedosaurians (Eosuchians, Rhynchocephalians and Sauamatan ancestors of Snakes and Lizards); Archosaurians (Thecodonts, Crocodilians, Saurischians, Ornithischians and Pterosaurians and Sauropterygians); Pelycosaurians and Therapsidans dominated the scene of the Earth of those times. The first or initial faunal exchange, dispersal and mixing of these ancient reptile faunal elements freely took place between India, Madagascar and North-east African portions of Pangaea - during that period only. By the end of Triassic the Pangaea began to break up into smaller land masses which later gave rise to the present day continents of Earth. By the end of Triassic the continents of South America, Africa and Asia started drifting apart while containing these original faunal elements of reptiles, which evolved independently in altered ecological conditions. All the said continents now separated by Tethys sea, into two land masses, a northern Laurasia and a southern Gondwana (Fig. 5)

At the end of Cretaceous when South America, Africa, India and Antartica were completely separated (Fig. 6), reptiles in India, particularly in the western Ghats evolved tremendously and became extremely diversified. The whole earth was a single landmass in the upper carboniferous period. Afterwards on account of certain natural changes in the lithosphere the landmasses were broken away and started drifting apart and the world has come to the present shape in due course. This phenomenon of spliting the continents from a single landmass provides suitable explanations of discontinous distribution of animals in recent times. Slightly before 65 million years ago in Paleocene epoch of lower (Oenozoic Era the portions of South-America, Africa and India were split apart and India started drifting in a north-wardly direction and ultimately joined the South-east portion of Laurasia. (Fig. 7). While these lithographic changes of Earth were taking place, dominant ancestral stock of Permian and mesozoic reptiles had undergone enormous changes in shape, size, structure and adapted themselves to survive in much diversified ecological circumstances. The second exchange of the Palaearctic, Indian, Indo-chinese and Indo-malayan faunal elements of reptiles took place on the maximum scale during this period lnly. Further evidence of single landmass or Pangaea is displayed by the carboniferous rocks of India, South Africa and South America which provide proofs of contemporary glaciation over them. All these areas were definitely close together near the south pole in carboniferous period. The landmass splited in Triassic and further subdivided in the Jurassic and the drift continued during the cretaceous and later periods. The flow of the glacier prevalied almost throughout the carboniferous period towards North-western, Northern and North-eastern regions from a central ice-covered region where Orissa, Bihar, Madhya Pradesh and West Punjab are situated now a days. The various species of reptiles and other animals survived in certain warmer pockets of southern portion of Western

Ghats of India and Sri Lanka. The follwing is the brief synthetic discussion and merits of the reptile fauna of Indian subregion at a zoogeographical point of view. By taking the numerous factors in to consideration, it is necessary to reassess the origin and dispersal of the various species of reptiles presently inhabiting India, tropical south Africa, Madagascar, Western Asia, North-east India, Malaysia, Java, Sumatra, Borneo and Australia. The Indian Peninsula was never under water ever since the cambrian period but the major portion of N. India including the region of Himalayas was under the sea. India had land connections with Madagascar and South Africa in Mesozoic and early Cenozoic periods. Recently Roonwal and Chhotani (1960) have brought important zoogeographical findings to the light of science in the field of termites (Insecta : Isoptera) and further prove and land connections of India with other areasd of the world in upper carboniferous period. Same theories can be very well fit in the case of reptiles also. Hora (1949) has established the continuity of Vindhya-Satpura hills with Assam Himalayas in the North-east and the Western-Ghats in the west. It has been proved that a land connection existed between Assam-Burma-Malaysia-Sumatra-Java and Borneo. The recent oceanographic survey of the floor of the Bay of Bengal has proved that submerged area near Sumatra, Java and Borneo was once above the water. The submerged coastal area "Sunda-shelf" is absolutely flat and the deposits on its surface are not of the oceanographic nature but agree with those which are generally brought and deposited by the rivers. "Sunda-shelf" before its submergence served as a bridge between Sumatra, Java, Borneo, many small islands (which are now submerged) and Malaysia. The sea-level increased abruptly after the carboniferous ice age and sea water engulfed the various lower coastal areas. The submergence was maximum near the Malayan Archipelago during the post-pleistocene period. Enormous volcanic activity took place during Eocene period in India and resultant lava covered almost whole of Peninsular India and as such has given rise to the formation of infra and inter-trappean beds. This great lithographic change helped in the formation of Deccan trap and had a prominent effect on the topography and climate of the region. At that time the flow of all the rivers of Peninsula was towards the north-west instead of west to east as we find now a days and the rivers like Narbada and Tapti were not at all in existance.

A constant geological phenomenon has caused the steep and straight elevation along the western coast and a simultaneous depression along the east coast of Peninsular India. The present shape of the western Ghats is since the pleistocene period. Such major changes in the physiography of Peninsular India were mainly experienced by the northern portion of the Western Ghats and most of southern portion either subjected to changes of lesser degree or remained unaffected. Possibly the whole of Indian Peninsula had the reaction of the great earth movements like the uplift of Himalayas, the general crust movements of the pleistocene and movements due to the scrap-faulting along the western coast. The Himalayan uplift might have caused the cracks in the northern part of the peninsula which ultimately might have created the Valleys for Narmada and Tapti rivers and possibly also helped in tilting of the Indian Peninsula from east to west.

The past physiographic conditions of peninsular India already discussed above

render an opportunity to realize that possibly this area itself in particular and India as a whole in general was the original home of the common ancestral stock of reptiles, much prior to the changes which took place in the northern western Ghats. This ancestral fauna of reptiles ultimately migrated to the adjoining areas in different and suitable intervals and subsequently by the lapse of time suffered from various changes on account of isolation in different ecological conditions. Ultimately many species or genera either remained unaltered or segregated into various allied species, subspecies and colour forms depending on their resistance of susceptibility in relation to the changed environment. The Indian reptiles (especially the Peninsular) represent the oldest element of fauna and most probably dispersed from here to Madagascar and South Africa in Mesozoic and early Cenozoic times, since the Peninsula had land connections with above areas in those days. Most of the species possibly flourished in Western Ghats and then the intertransmission took place between this region and other parts like Tropical South Africa, Madgascar, Western Asia, Assam, Burma, Malayan Peninsula, Java, Sumatra and Borneo. This admixture of the reptile fauna continued so long as the land connections (as already mentioned) prevailed between these land masses. Possibly the intermigration of this fauna took place on account of basic natural needs like food, breeding and climatic unstability in one or another region mentioned above. The over- crowding of the fauna might be also one of the reasons of the dispersal. The major portion of the western Ghats, like these days was covered with dense tropical forests and was much humid when the reptilian faunal dispersal took place.

Affinities of the reptiles of India:

The excavation of the pilocene Siwalik fauna of Himalayan foot hills established the fact that the present day fauna of Tropical South Africa and Western Asia has a close similarity with it and might have descended from the same stock which inhabited the Peninsular India. The occurrence of the Siwalik fauna of Himalayas in the mountains of Southern India, and in Burma and even further sough up to Sri Lanka gives a suitable support to this idea. Further it has been observed that no records indicating the presence of unaltered or allied Siwalik species in the intervening areas of Peninsula. Such a type of migration of temperate Himalayan reptiles to the hilly areas of southern India and Sri Lanka and the presence of Burmese and Malayan reptiles in the present reptile fauna of Peninsular India provides an explanation for the origin of ancestral reptiles from the western portion of the Indian Peninsula. Many Zoogeographers give the reasons of this faunal anomaly as a result of Glacial Epoch. In this connection Prasad (1942) states "At the present day the comparatively narrow plains of the Brahmaputra in Assam is far more extensively covered with forests than the much broader Gangetic plain, and if, as is possible, the same difference existed at the close of the Glacial Epoch, it is easy to understand why the Trans-Gangetic fauna of Burma and South-east had greater chances of occupying the vacant region of the Himalayan than the cisGangetic fauna which had been driven much further south by the cold."

Probably the original home of the reptiles now inhabiting South Africa, Madgascar and Western Asia was the tropical India and the ancestral groups

migrated there in Mesozoic and in the beginning of Cenozoic times, when Indian Peninsula had a land connection with these parts. The present condition shows that the reptile fauna of Peninsular India, on one side is well represented in Assam, Burma and Malayan Peninsula while on the other it is absolutely absent from the northern India. It seems that in the beginning the main concentration of the reptiles in India was at lower portion of western Ghats and from there the migration took place to Assam hills through Satpura-Vindhya ranges, many migrated species which could remain unlatered in both the regions till present times, reached up to Java, Sumatra and Borneo.

This migration of the reptile species took place much ealier to the following geological changes: 1. The sub-mergence of Assam, Burma and parts of the Malayan region. 2. The changes which took place in the northern western Ghats. 3. The changes which took place in the topography of the area between Satpura-Vindhya and Assam hills "Garo-Rajmahal Gap."

On account of this migration of the reptile species from Peninsular India to other connected parts many ancestral groups of genera had to segregate gradually into the allied species. This was possibly due to the parallel evolution on account of the changed environment.

The change in any of the species has not gone beyond a species step, which indicates that the isolation in case of these allied species must not be older that a million years.

Present distribution patters of reptiles in India and their relations with adjoining zoogeographical Regions:

1. **Species exclusively to the Indian subregion:**
   The following species are mainly from the climatically diversified geographical zones of Indian subregion namely the desert area of Rajasthan and North-western India; Kashmir and the western Himalayas; the Plains of Ganga and Yamuna; central India; the Indian Peninsula; Western Ghats; Eastern Ghats; The Chota Nagpur area and the North-east Indian including Eastern Himalayas. *Testudines* : Only one species viz., *Hardella thurgi* is endemic to this subregion.
2. **Species which are common to the Oriental and Palaearctic Regions:**
   Testudines: Family Emydidae: *Geoclemys hamiltoni, Kachuga dhongoka, Kachuga kachuga, Kachuga smithi, Kachuga sylhetensis, Kachuga tecta, Kachuga tentoria* and *Kachuga trivittata.* Family Testudinidae: *Geochelone elegans, Geochelone platynota, Geochelone elongata, Geochelone travancorica, Geochelone emys, Geochelone impressa* and *Testudo horsfieldi.* Family Trionychidae: *Lissemys punctata, Chitra indica* and *Trionyx gangeticus.*
3. **Species exclusively endiemic to the Indo Chinese and Malayan subregions.**
   Testudines : Family Platysternidae: *Platysternum megacephalum.* Family Emydidae: *Pyxidea mouhoti, Cyclemys dentata, Cuora amboinesis, Damonia subtrijuga, Hieremys annandalei, Notocheyls platynota, Siebenrockiella crassicollis,*

Clemmys mutica, Clemmys bealei, Chinemys reevesi and *Ocadia sinensis.* Family Trionychidae: *Pelochelys bibroni* and *Dogania subplana.*

4. **Species common to Indian, Indo-Chinese and Malayan subregion.**
   Testudines: Batagur baska, Melanochelys tricarinata, Melanochelys trijuga, Morenia ocellata, Morenia petersi and *Chitra indica.*

Class REPTILIA

The cold blooded (ectothermic or poikilothermic) lungs breathing tegrapod amniotes form the class Reptilia of the vertebrates. Reptiles are unable to maintain a definite body temperature and it changes according to the temperature of the surroundings in which they live. On account of the behavioural thermoregulation reptiles have developed definite physiological attitudes and have evolved suitably to lead a complete terrestrial life and do not depend on water for breeding at any stage in their life cycle. An extraordinary evolution had taken place in the egg of reptiles which is a closed box like structure and known as cloidoic egg (Figs 8&9). The reptilian cleidoic egg is quite large, with a strong leathery or calcarious shell. The shell being porous acts as a semipermiable membrance for the exchange of oxygen and carbon dioxide and aids in the respiration of the fast developing embryo. The shell also protects the developing embryo from any mechanical damage on account of jerks. The egg contains a large amount of yolk and albumen which provide food and water to the embryo for growth and development. At the later stages of development the embryo is surrounded by an amniotic bladder (fluid filled sac) which renders strong protection to the embryo against the mechanical jerks and from abrupt change in the temperature. The hind gut of the embryo gives rise to a second bladder known as allantois, which provides an extraordinary vascular surface to the inner shell-lining and helps the embryo in the respitation. The allantoic bladder also stores the uric acid and nitrogenous waste of the embryo, which is left behind at the time of hatching. The external fertilization is not possible in reptiles as all the contents of the egg are covered by a leathery, calcarious shell and thick coating of the albumen. In all the reptiles after copulation the development of the embryo and fertilization takes place internally in the body of the female much prior to the formation of albumen and the shell contents in the oviduct. Most of the reptiles are oviparous and lay eggs which are hatched by external heat. But in many species of lizards and snakes development takes place inside the body of the mother and the yound are produced alive and this phenomenon is called as ovo-vivipary and vivipary. On account of a box like cleidoic egg and internal fertilization reptiles lay their eggs on the dry land and never depend on aquatic medium like amphibians for egg laying.

Main characters of reptiles:—

Skull: Skull is complicated and most important structure in reptiles and its temporal region has got a great evolutionary significance. The structure of the temporal region has been utilised as basis for the primary classification of reptiles by the various workers of repute and in fact it serves all the useful purpose in dealing with the reptile taxonomy. Atlas vertebra generally articulates with the skull through a

single tripartite occipital condyl in all the reptiles (Figs. 10-12). Osborn (1903) suggested the primary classification of reptiles on the basis of the structure of temporal region of the skull. He divided the class Reptilia in two primary subclasses on the basis of the openings in the temporal region of the skull as follows: Subclass Synapsida: All the reptiles with only one fenestra or fossa in the temporal region. This subclass was further divided into four major groups viz., Cotylosauria, Anomodontia, Testudinata and Sauropterygia. Subclass Diapsida: All the reptiles with two fenestra or fossae in the temporal region. This subclass is also further divided into seven groups viz., Diptosauria, Phytosauria, Ichthyosauria, Crocodilia, Dinosauria, Squamata and Pterosauria. Williston (1925) by keeping the Osborn's scheme as a basis, profound a classification in which he divided the class reptilia into five subclasses namely Anapsida, Synapsida, Synaptosauria, Parapsida and Diapsida. He retained the Synapsida and Diapsida of the original classification of Osborn after introducing numerous changes Williston included the Cotylosaurians and Chelonians of Osborn into a distinct subclass Anapsida on the basis of the complete roofing of the temporal region, which means that the temporal region is absolutely devoid of the openings. (Figs. 13-16). Sauropterygia of Osborn, which included the reptiles with a single supratemporal fossa was also removed from his subclass Synaptosauria. All the reptiles with a single temporal fossa above the junction of Postorbital and squamosal were removed from the Diapsida of Osborn and were place under a separate subclass Parapsida (Figs. 17, 18), which included Mesosauria, Ichthyosauria, Protosauria and Squamata. All the extinct mammal like reptiles with a single temporal opening were placed under the subclass Synapsida (Figs. 19-22).

Subclass Diapsida of Osborn and Williston includes all the extinct primitive ruling reptiles ancestral to birds, Archosaurians (dinosaurs), Crocodilians; Diaptosaurians (Rynchocephalia); lizards and snakes. In all the roof of the temporal region is perforated by two openings *viz.*, an upper-supratemporal fossa and a lower-infratemporal fossa (Figs. 23-27).

Romer (1956-1957) further changed the classification of Williston and the following improvements were incorporated. (1) Order Mesosauria was removed from the Parapsida and placed under the Order Cotylosauria (2) Subclass Synaptosauria of Williston was renamed as subclass Euryapsida (3) Subclass Parapsida was merged with the Order Sauropterygia of subclass Euryapsida. (4) Diapsid orders Eosuchia, Rhynchocephalia and Squamata were properly placed under a distinct subclass lepidosauria and exact diapsid status of snakes and lizards was established. (5) Diapsid reptiles like Thecodonts, Crocodilians, Saurischians, Ornithischians and Pterosaurians were placed under separate subclass Archsauria.

Ultimately in the year 1966 Romer could give the following excellant classification to the reptiles, mainly on the basis of the architecture of the temporal region of the skull.

Class Reptilia (Romer 1966)		FAMILIES	
		Extinct	Surviving today
	Subclass Anapsida		
	Order Cotylosauria	14	NIL
	Order Chelonia	12	11
Reptiles which were removed from the subclass Diapsida of Williston (1925) and elevated as two new subclasses in this new scheme of Romer.	Subclass Lepidosauria		
	Order Eosuchia	5	NIL
	Order Rhynchocephalia	5	1
	Order Squamata		
	Suborder Sauria	11	20
	Suborder Serpentes	2	11
	Subclass Archosauria		
	Order Thecodontia	8	NIL
	Order Crocodilia	11	1
	Order Saurischia	15	NIL
	Order Ornithischia	10	NIL
	Order Pterosauria	4	NIL
	Subclass Ichthyopterygia		
	Order Ichthyosauria	5	NIL
	Subclass Euryapsida		
	Order Protosauria	5	NIL
	Order Sauropterygia	15	NIL
	Subclass Synapsida		
	Order Pelycosauria	8	NIL
	Order Therapsida	49	NIL

The lower jaw or mandible (Figs. 28-31) forms a complex of small bones. Each ramus is generally an elongated and slightly curved structure formed basically by the combination of seven bony elements viz., preaticular, angular, articular, surangular, opercular or spleniod, coronoid and dentary. The intermandibular articulation is generally ligamentous in living forms. The articular bone of the mandible articulates with the quadrate bone of the cranium. In Squamata and Rhynchocephalia, the articulation of mandibles with skull and the intermandibular articulation bears considerable taxonomic significance. The comparison of these structures between the living and fossil forms can serve as one of the important tools in tracing the exact ancestry of the modern reptiles. In Crocodilians and Testudines, the articulation of mandible with the skull is quite firm but in lizards and snakes it is flexible. This type of loose articulation of mandible with the upper jaw provides a great flexibility and mobility in the jaws of snakes and most of them can swallow victims much larger than the

normal size of their mouth. The auditory complex is composed of tympanum, prootic and opisthotic, forming an auditory capsule in lizards, crocodilians and most chelonians. The columella auris is a rod-like structure and is composed of two parts, a slender rod like stapes and a cartilaginous tubercle, the extrastapes. The flac and disk-like proximal invagination of stapes remains in close contact with the membranous lid of fenestra ovalis. The distal end of stapes extends up to the capitulla of quadrate. The extrastapes is an importnat replacing bone of the auditory capsule, attached on each side with stapes and on the other with tympanic membrane. In Crocodiles, Testudines and Saurians an external eardrum is visible. In certain burrowing lizards, the ear-drum (tympanum) is concealed. Snakes are absolutely devoid of external ear openings, tympanum and the tympanic cavity. The sense of hearing is feeble in Squamata. Crocodilians are least sensitive to most sounds but Testudines respond to sound in a range of 110 cycles per second.

Vertebral column (Fig. 32) Vertebral column exhibits tremendous variations and is made up of procoelous vertebrae, the maximum number available is 55 in Testudines, 66 in Crocodiles, 60 in lizards and 400 in snakes. In Testudines vertebrae reach to a fewest number which may be reduced to 36 in *Terrapene*, and reach to a highest number of 400 in the Pythons. Generally 7 cervical vertebrae are present, the first 3 viz., the atlas, the axis and the third one are devoid of ribs; the remaining 4 possess free ribs. The atlas is devoid of neural spine and transverse process, its dorsal surface bears a flat neural arch formed by the union of the lateral neurapophysis. The axis vertebra is devoid of transverse process and bears a pointed, posteriorly directed, laminar neural crest on the dorsal aspect. The thoracic vertebrae are generally 18 in number, and possess well developed pre-and post zygapophysis, neural spines, and cup- shaped sockets at the base of antero-lateral aspect of the cranium for providing movable articulation to ribs. Generally there is a single lumber with a strong antero-dorsally pointed pre-zygapophysis and a well developed transverse process lying between the thoracic and the sacral vertebrae. Lumber is devoid of ribs. Two sacral vertebrae are generally available which bear well developed and expanded lateral transverse process. In sacrals the neural spines are less prominent, generally the haemal arches are missing; pre-and post zygapophysis are well developed and the transverse process of anterior sacral is stronger than that of the posterior one in most of the modern lizards. The caudal vertabrae are generally 29 in number which are differentiated into three types, thus (i) The intermediate postsacrals with a well developed transverse process, neural spine and without haemal arches. (ii) The remaining anterior caudal vertabrae with transverse process, neural spines and haemal arches. The haemal arches or chevron bones are the ventral extensions which emerge from the centrum (intercenturm) and form a demarcation between the caudal muscles. (iii) The elongated tubular posterior tail vertebrae without transverse process and neural spines but with well developed pre - and post zygapophysis. Ribs : (Fig. 33) These are generally well developed in Crocodiles, Saurians and Rhynchocephalians and are generally in 22 pairs.

Pectoral girdle : (Fig. 34). In most of the living reptiles the Pectoral girdle is partly cartilaginous and partly bony paired structure, articulating with fore limbs at glenoid fossa, and sternum. It is composed of six bones *viz.*, the scapula, suprascapula,

coracoid, epicoracoid, clavicle and interclavicle. The suprascapula and epicoracoid are cartilaginous structures while the other four are bony. The clavicles are curved bones on the ventral side, articulating with the interclavicle, epicoracoid and scapula. The Interclavicle is a T-shaped median ventral bone lying beneath the sternum. The Suprascapula is a thin cartilaginous bone attached to the dorso-lateral edge of Scapula, which forms a dorso-lateral bony extension of pectoral girdle, and forms a sutural articualtion with coronoid. The coronoid is a large flat slightly convex structure bearing the glenoid fossa. *Forelimbs* : (Fig 34) Forelimbs consists of humerus, ulna, radius, carpals, metacarpals and phalanges. The bicipital fossa of deltoid ridge of humerous possesses many formina. The metacarpals are five in number, the phalangial formula is 2, 3, 4, 5, 3 and the corpus is formed by 9 elements in Saurians and Rhynchocephalians. *Pelvic* girdle : (Fig. 35) It is composed of two triradiate elements to form a bilaterally symmetrical composite structure. Each triradiate half consists of three bones viz., pubis, ischium, and ilium. The pubis, ischium and ilium of each innominate fuse with one another on the lateral aspect and the sutures between them are not distinct. *Hindlimbs* : (Fig. 35) Each limb consists of femur, tibia, fibula, tarsus and pes. The tarsus is made up of 6 parts and metatarsals are 5 in number, the third and fourth are of equal size; the phalangeal formula is 2,3,4,5,4. The limbs are much reduce or even absent in many lizards. In snakes these are altogether missing. Most of the reptiles capture their food by undertaking the fast movements of the body and through vigorous chase of the prey. This phenomenon effects the skeletal and musculature systems and tends to form the bones more ossified and in the formation of stronger musculature. The head is kept high of the ground and rotated freely. The orbits become bigger in land forms. The first two cervical vertebrae form an efficient atlas-axis complex and the cranium bears a single occipital condyl.

Egg tooth : The embryos of the oviparous reptiles (Testudines, crocodiles, lizards and snakes) possess a sharp calcarious "egg-tooth" on the top of snout, which they use to break the egg-shell for coming out of it. The egg-tooth is shed after the birth.

Blood & Vascular System : (Fig. 36 & 37) The red blood corpuscles (erythrocytes) are nucleated, biconvex and oval. The heart is generally three chambered, two auricles and a ventricle but in crocodiles the heart is almost four chambered and the mixing of arterial but in crocodiles the heart is almost four chambered and the mixing of arterial and venus blood takes place only through a valve (in interventricular septum) called foramen of Panizae. In crocodiles pulmonary and systemic circulations are thus only partially separate. Both the right and left aortic arches are complete and functional. The heart is always enclosed in a pericadium.

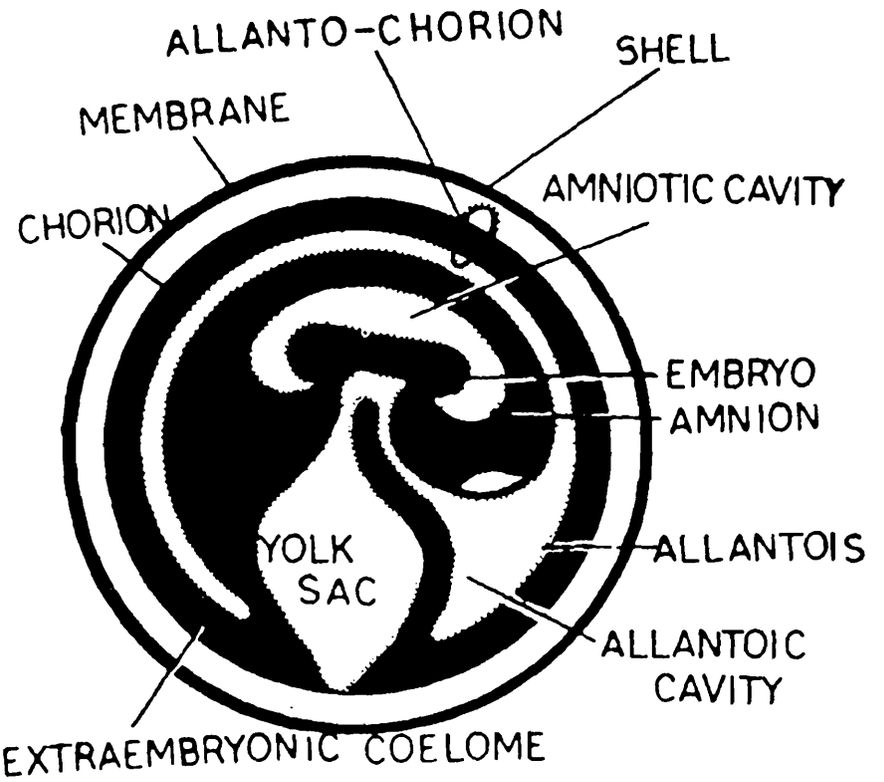
Body cavity : Diaphragm is not present in reptiles. In crocodilians one allied transverse structure develops, which completely separates the heart, lungs, and liver from the abdominal cavity. This partly muscular structure assists in the respiration in crocodiles like the diaphragm of mammals.

Respiration : All the reptiles are with two lungs. In crocodiles and testudines lungs are well developed and spongy. In turtles the respiration is effected by the enlargement of the body cavity through rotation of the limb girdles and on account of the movements of the abdominal muscles.

Buccal cavity, Digestive and Urinogenital systems : The buccal cavity in reptiles is devoid of cheeks. In Testudines and Crocodilia the buccal cavity is separated from the nasal passage by a secondary palate. The tongue in most reptiles is highly sensitive, mobile and in some cases extensible. Tongue also participate in capturing the prey along with teeth and horny jaws in reptiles. Tongue is a short and broad structure in Testudines and Crocodiles and is attached to the floor of the mouth and can be elevated but cannot be protruded. Reptiles are devoid of real functional salivary glands but in snakes the liable glands are modified to form the venom glands. Most of the reptiles can produce sounds at times and all of them have sense of smell. The stomach in reptiles bears a sufficient storage capacity and allows large volume of the food to be taken. The intestine empties into a terminal chamber of the gut called as cloaca, which also receives the products of kidneys and reproductive organs. The external opening of the cloca is transverse in the lizards and snakes, almost longitudinal in testudines and crocodilians. The cloaca is divided into three compartments - viz., proctodaeum, urodeum and coprodaeum. The structure and position of these cloacal chambers vary significantly in different orders of reptiles. Copulatory organs are contained by the proctodaeum; ureters, vasa deferentia, oviducts and bladder opens into the urodeaum in testudines and lizards; the same is the case in crocodiles and snakes except that the bladder is not present in them. The coprodaeum is for the storage of faces and is available as a separate chamber in lizards and snakes only; in the testudines and crocodiles coprodaeum and urodaeum are united. Testudines and crocodilians excrete the liquid unine, while snakes and lizards excrete solid crystals of insoluble urates. The copulatory organs are not present in Rhynchocephalians; in crocodilians and testudines an unpaired penis emerges from the ventral wall of the proctodaeum which is extruded through the anterior end of the cloacal slit. On its dorsal surface there is a deep grove which leads back to the openings of the seminal ducts. In snakes and lizards copulatory organ is paired and called as hemipenis. Each hemipenis is a tubular structure of erectile tissue, which protudes inside out, like the finger of a glove, through the side of cloacal opening. The retraction of the hemipenis is aided by special muscles of the tail musculature. Each hempenis is grooved on its surface for the conduction of the seminal fluid. Only one organ functions at a time and depends upon the side the male happens to be at the time of copulation.

Nervous system : The cerebrum is moderately developed in reptiles and never covers the mid-brain. Optic lobes are two in number and are situated on the anterodorsal aspect of the moderately developed cerebellum. Olfactory bulbs are clubshaped and are connected with the cerebral hemispheres through the olfactory tracts. Infundibulum and pituitary are moderately developed.

Eye : All the reptiles have eyes with eye-lids at one or the other stage of the life cycle. In snakes the eye-lids are missing in the adult animals but these are available in rudimentary condition in their embryos. In lizards eye-lids may be movable or fixed. The nictitating membrane is also available in the reptilian eye. Lacrimal and Harderian glands which are present in the eyes of the reptiles, form secretions, which keep the eye moist. In many reptiles a ring of horny plates supports the eye and protects it from external injuries.



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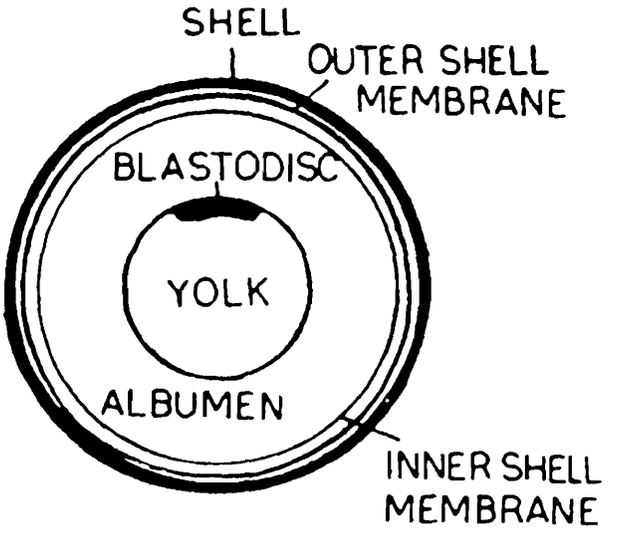

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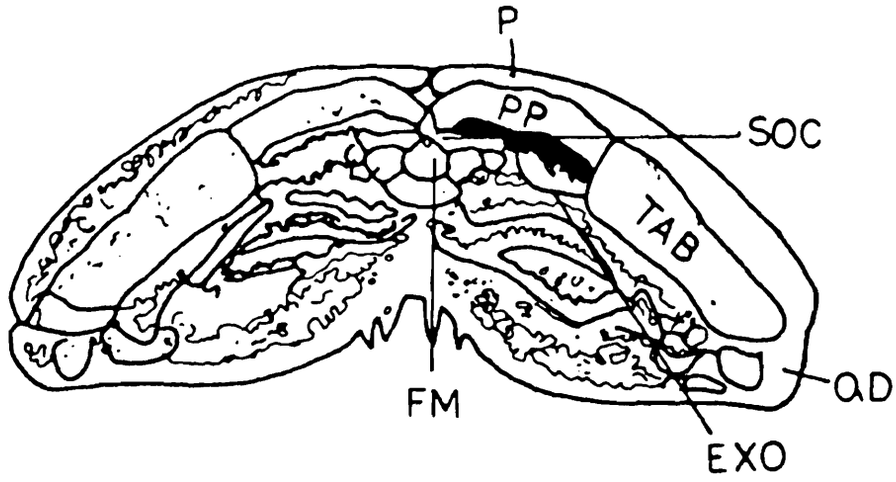
Fig.8. Cleidoic egg of Crocodile.

Fig.9. Egg : Testudines and Crocodila.



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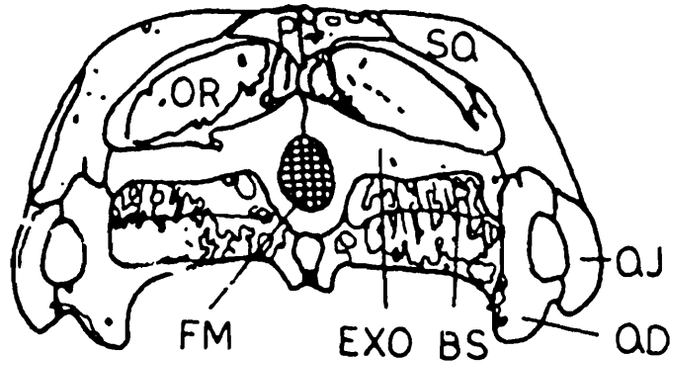

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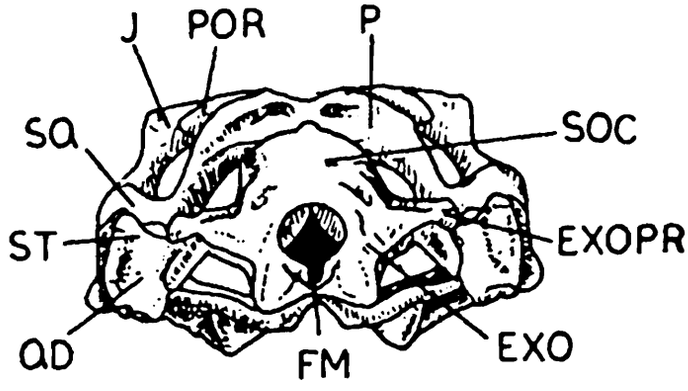

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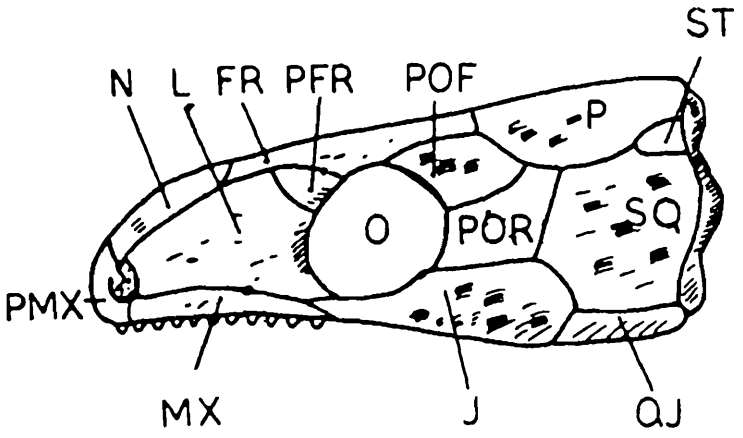
Fig.10. Skull (Occipital region) : *Labidosourus hamatus*

Fig.11. Skull (Occipital region) : *Sphenodon punctatus*

Fig.12. Skull (occipital region) : *Japalura variegata*



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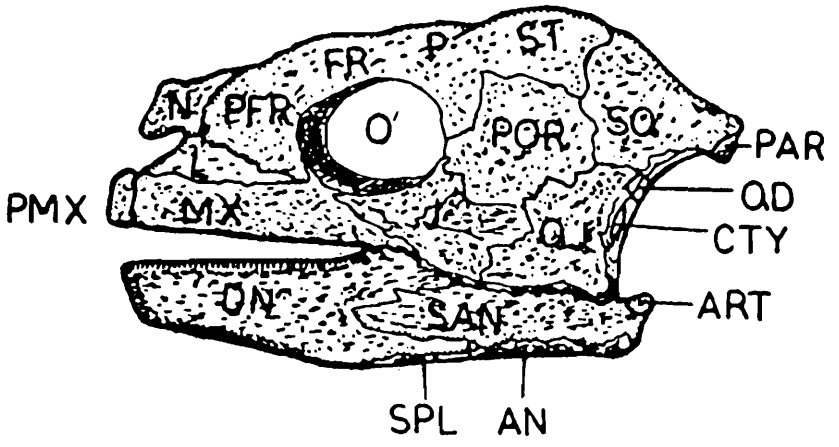

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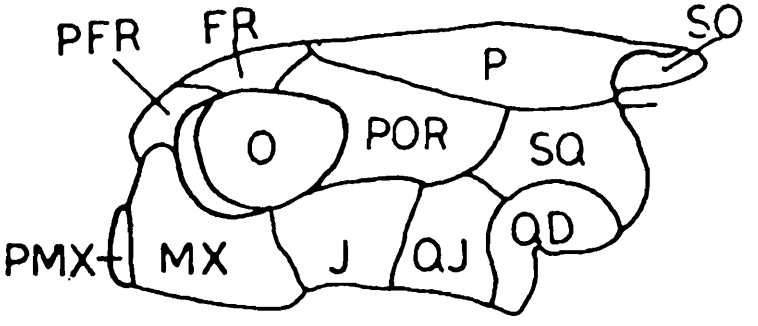

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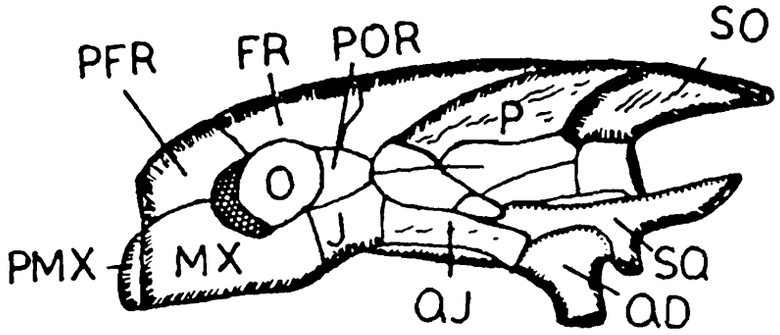
Fig.13. Anapsid skull :
Fig.14. Skull (left view) : *Triassochelys dux* of Triassic
Fig.15. Skull of Chelone (typical anapsid condition)



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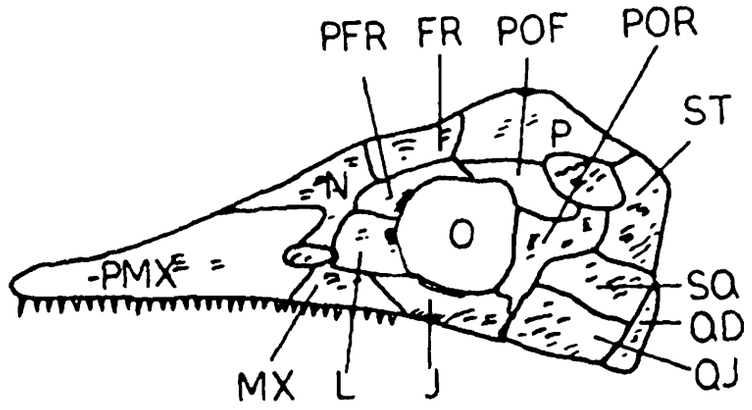

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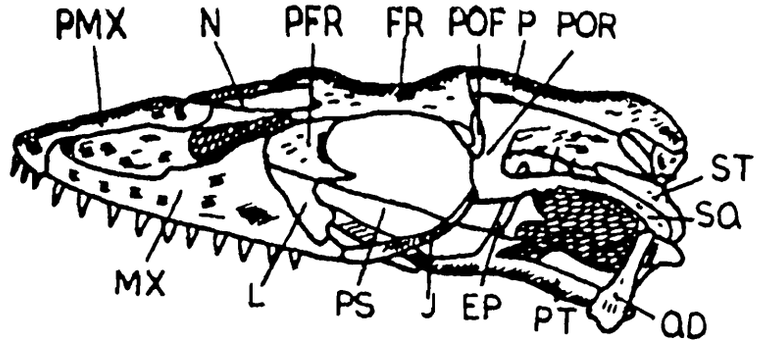

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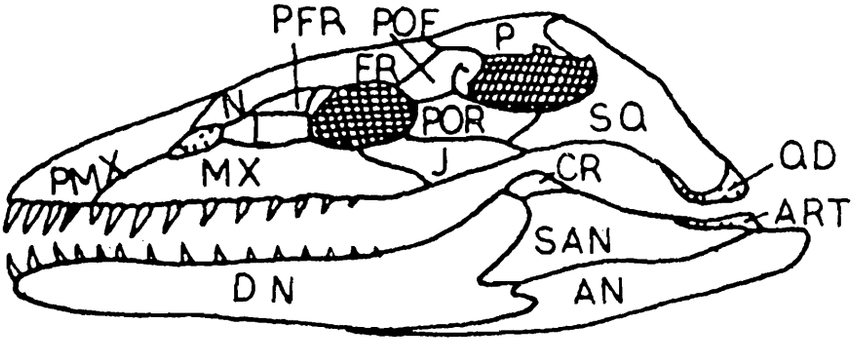
Fig.16. Skull of Testudo (anapsid skull showing the temporal root emarginated from behind)

Fig.17. Parapsid skull : Ichthyosaurus (Lateral view).

Fig.18. Parapsid skull : Varanus (Lateral view)



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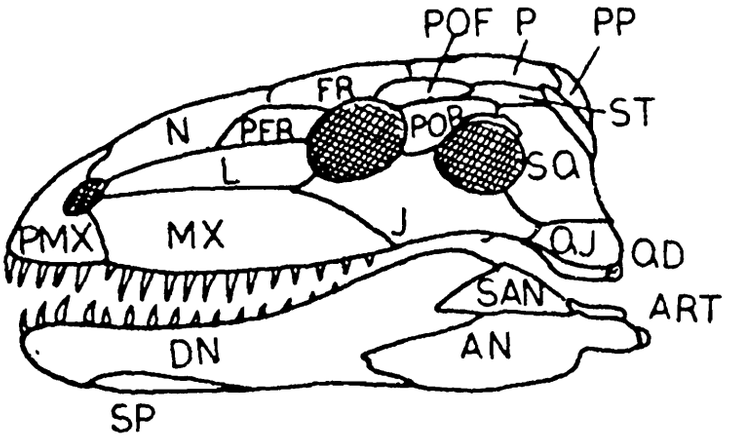

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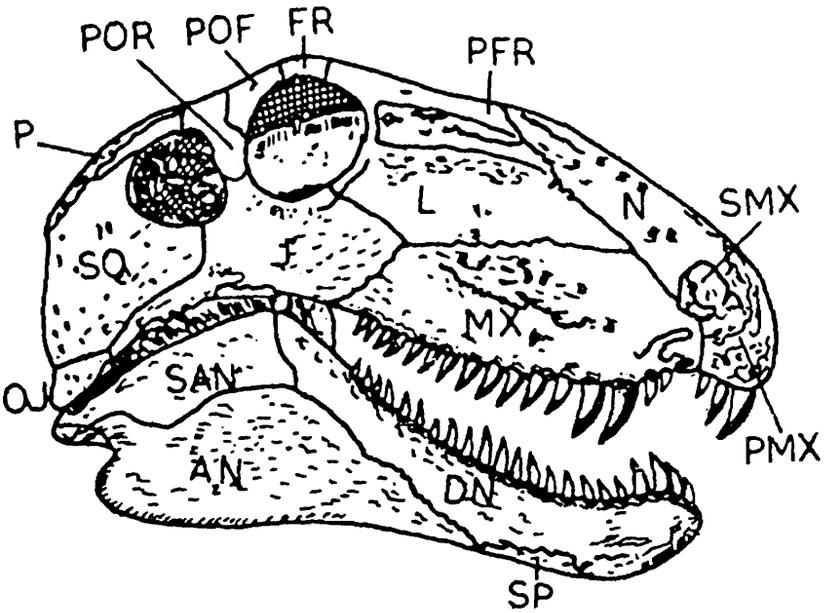

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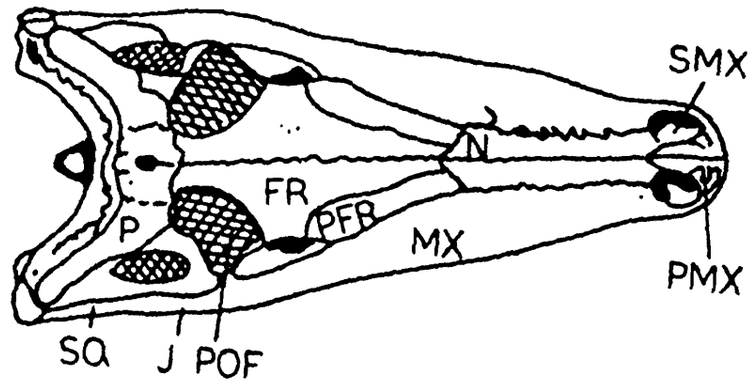
Fig.19. Synapsid skull : Plesiosauria (Lateral view)

Fig.20. Synapsid skull : Pelycosauria (Lateral view).

Fig.21. Synapsid skull : Sphenodon (Lateral view)



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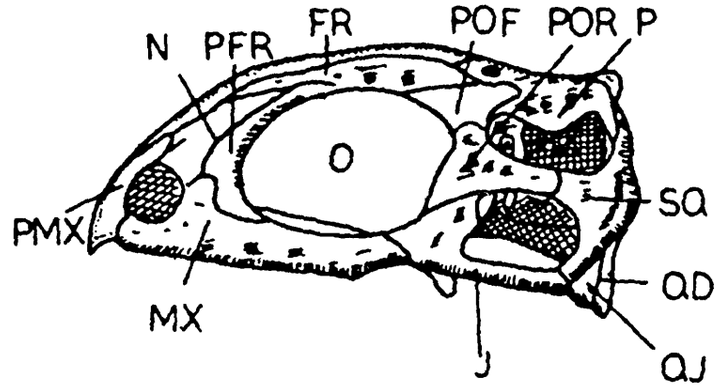

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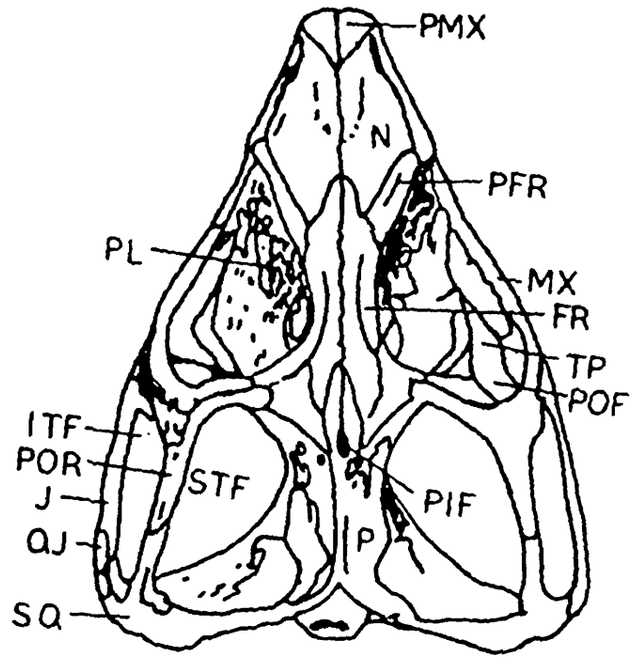

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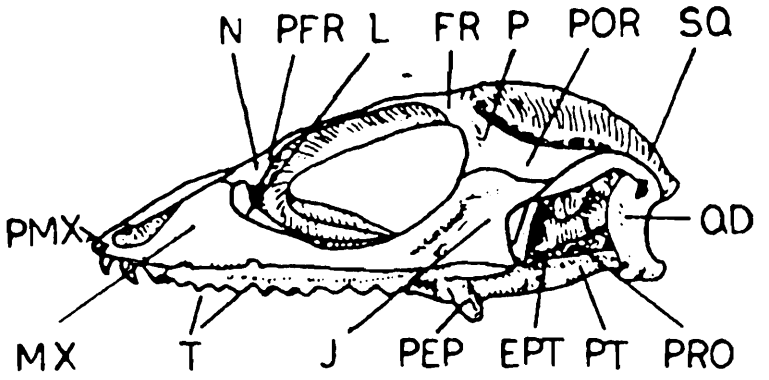
Fig.22. Synapsid skull : Sphenodon (Dorsal view)

Fig.23. Dipsid skull : Sphenodon (Lateral view)

Fig.24. Skull : *Sphenodon pemctatus* (Dorsal)



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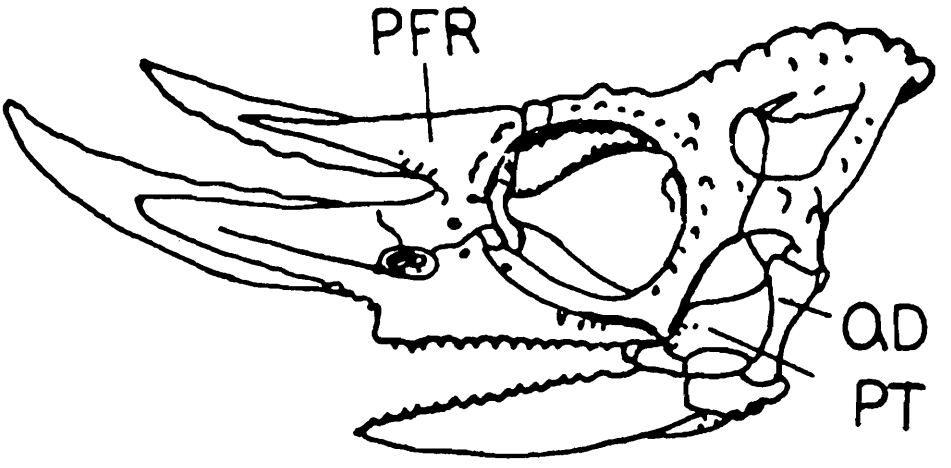

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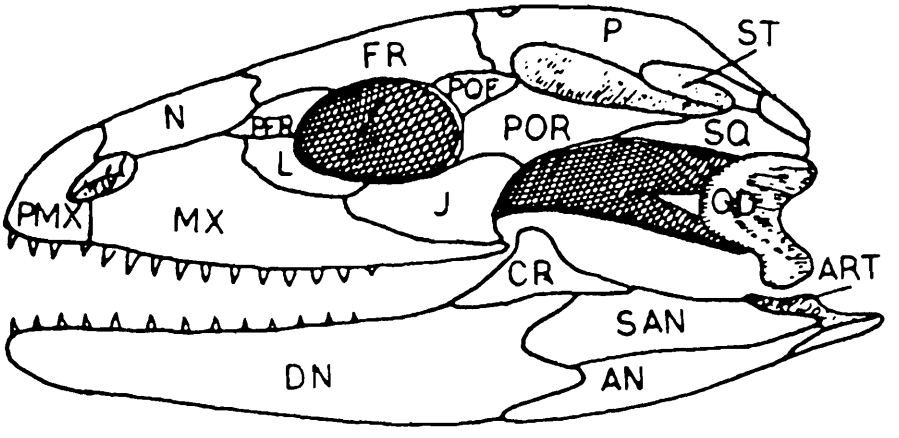

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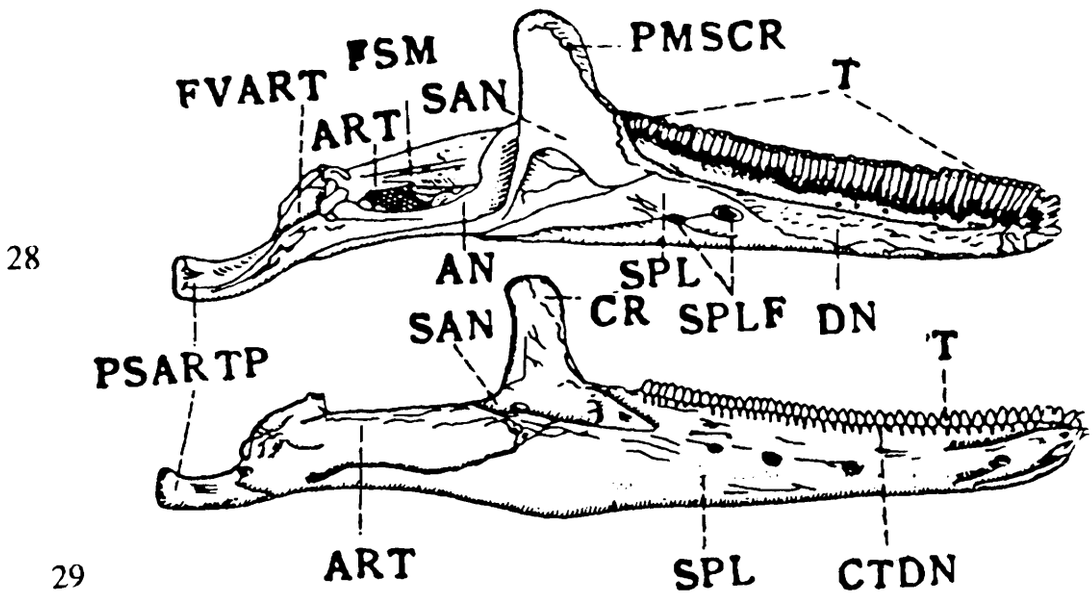
Fig.25. Skull : *Japulura variegata* Gray.

Fig.26. Skull : Chamaleo

Fig.27. Skull of a lizard (side view)



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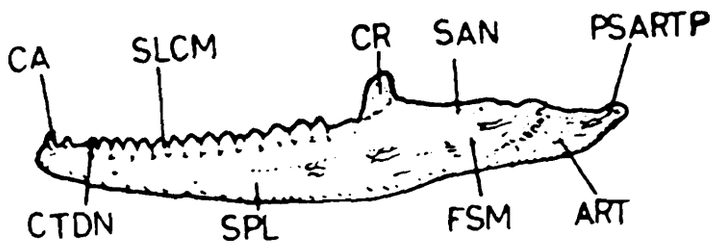

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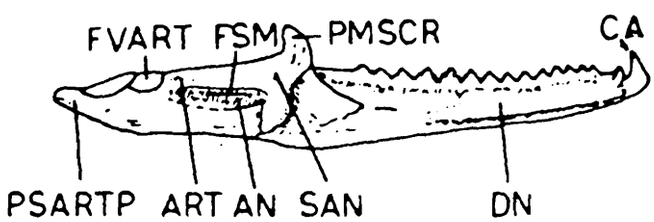

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Fig.28. Inner view of the mandible

Fig.29. Outer view of the mandible

Fig.30 & 31. *Japalura variegata* Gray : Lower jaw – outer and inner view.

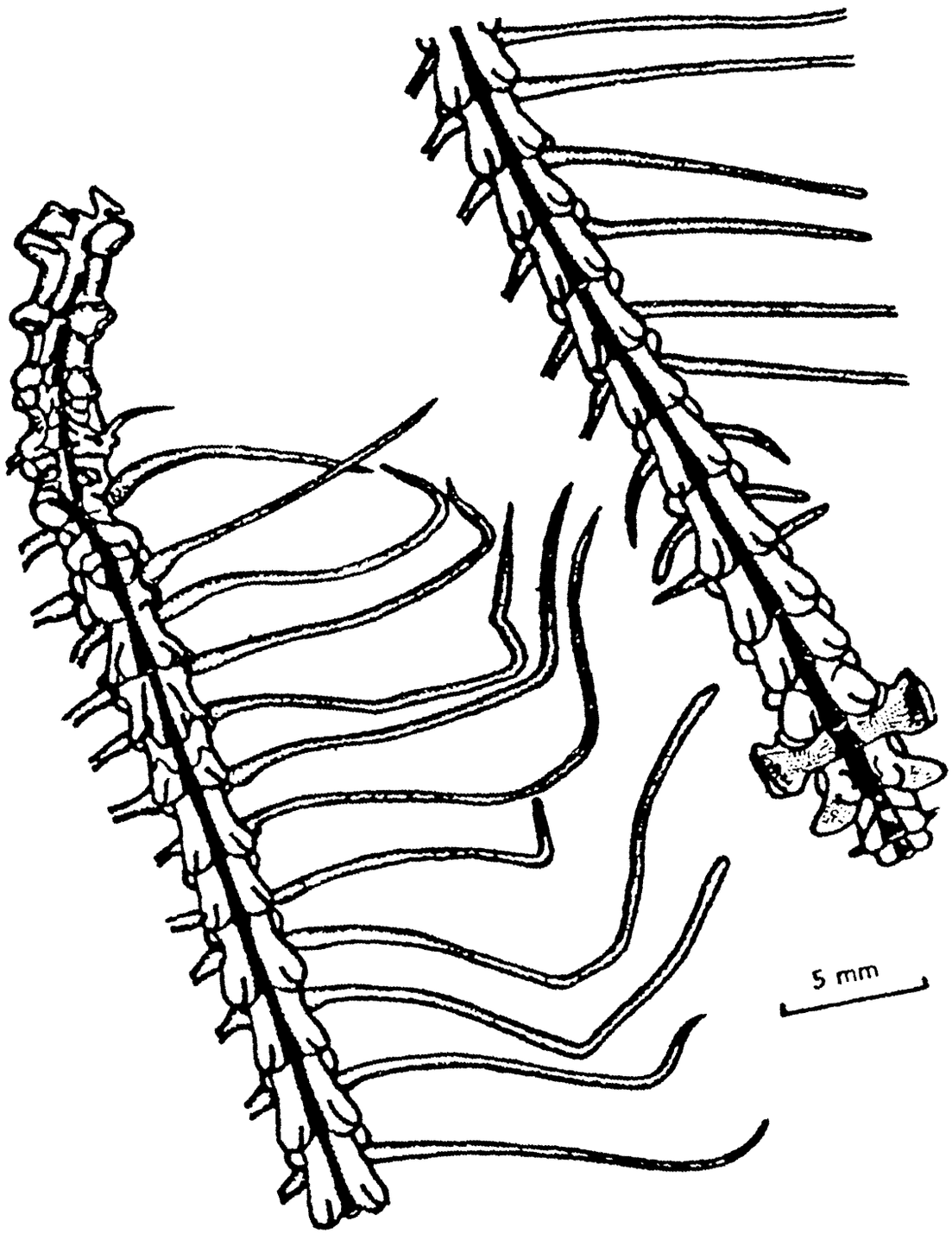

Fig. 32. Vertibral column of reptile

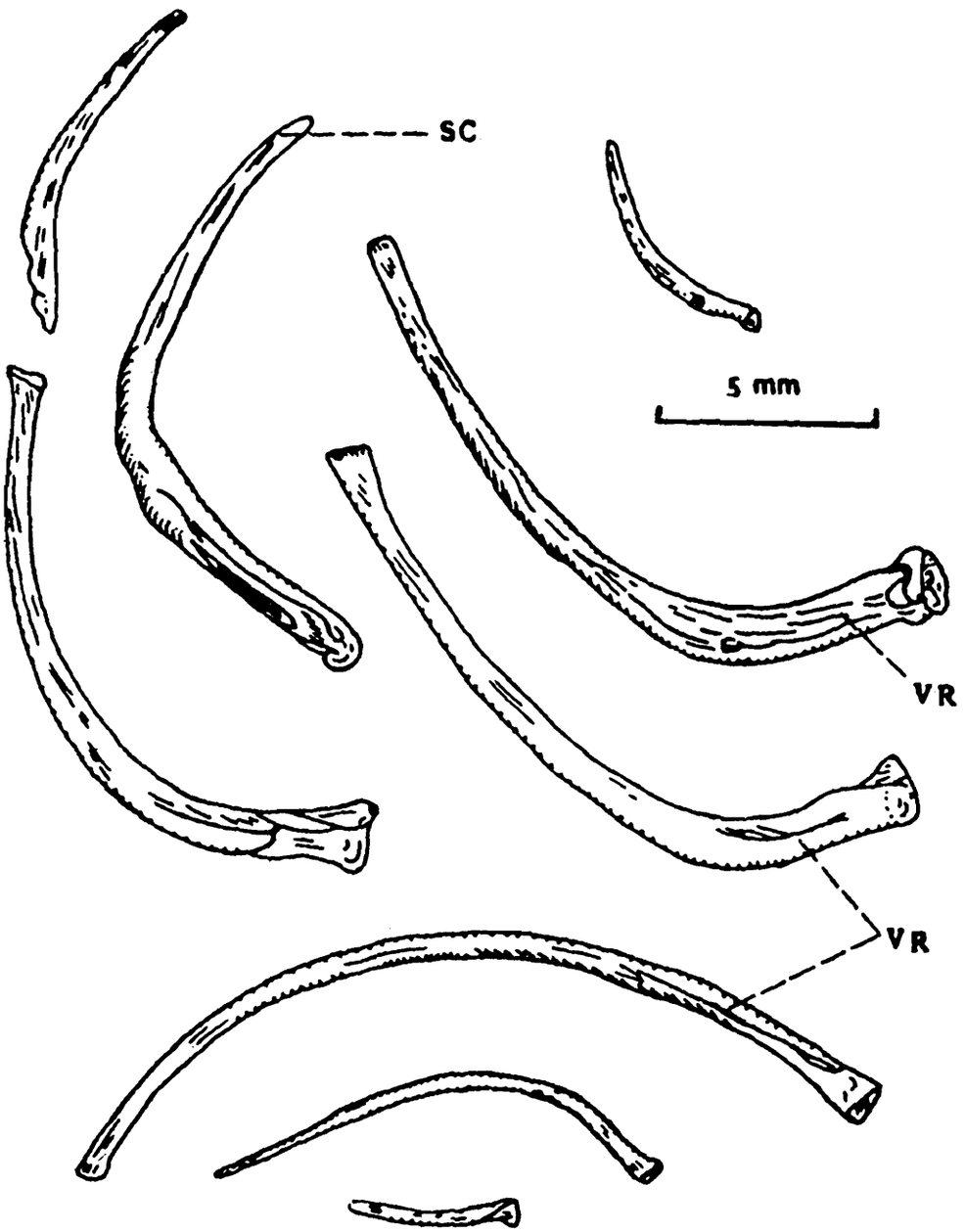

Fig. 33. Ribs of a reptile

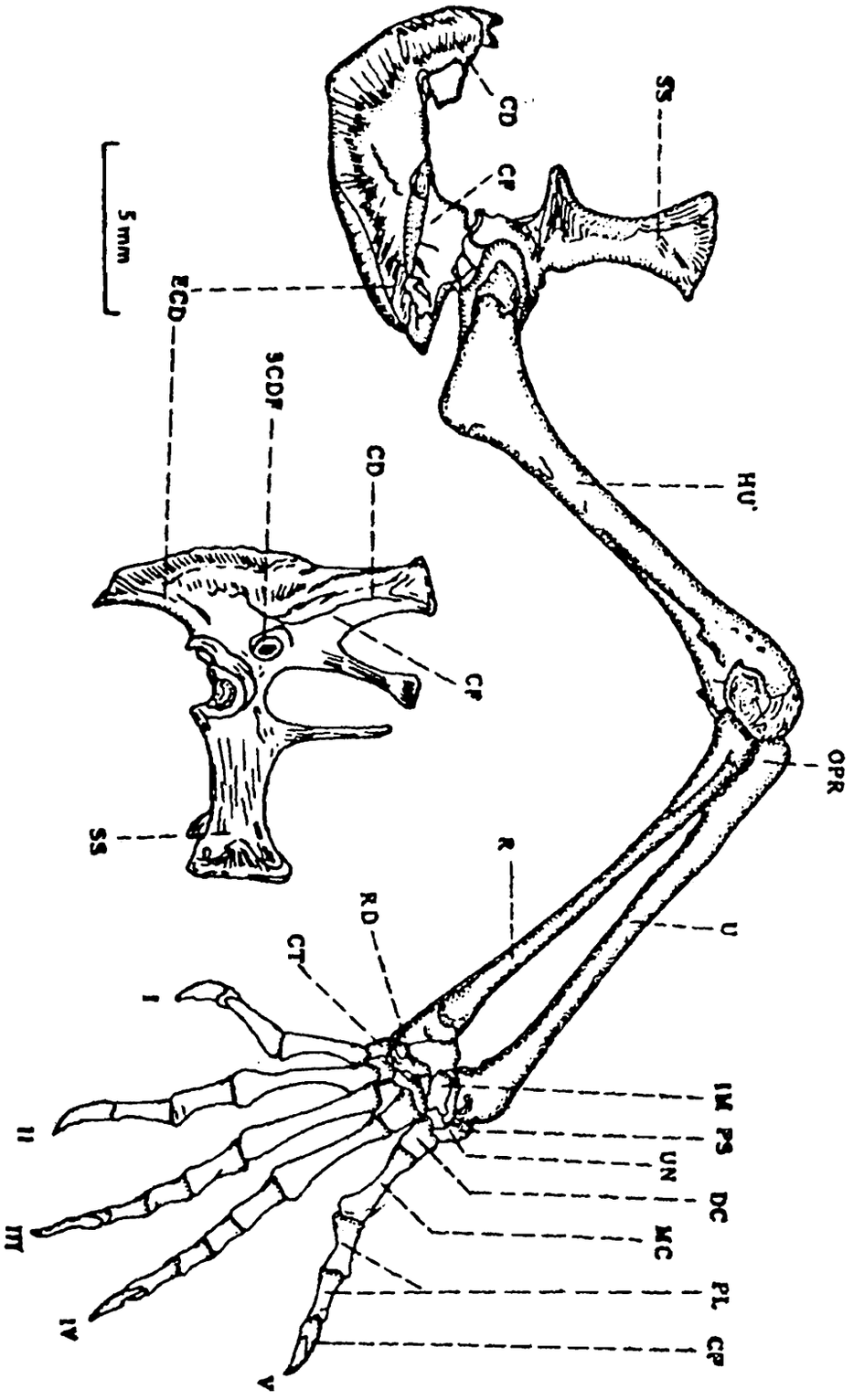

Fig. 34. Forelimbs and pectoral girdle of a reptile

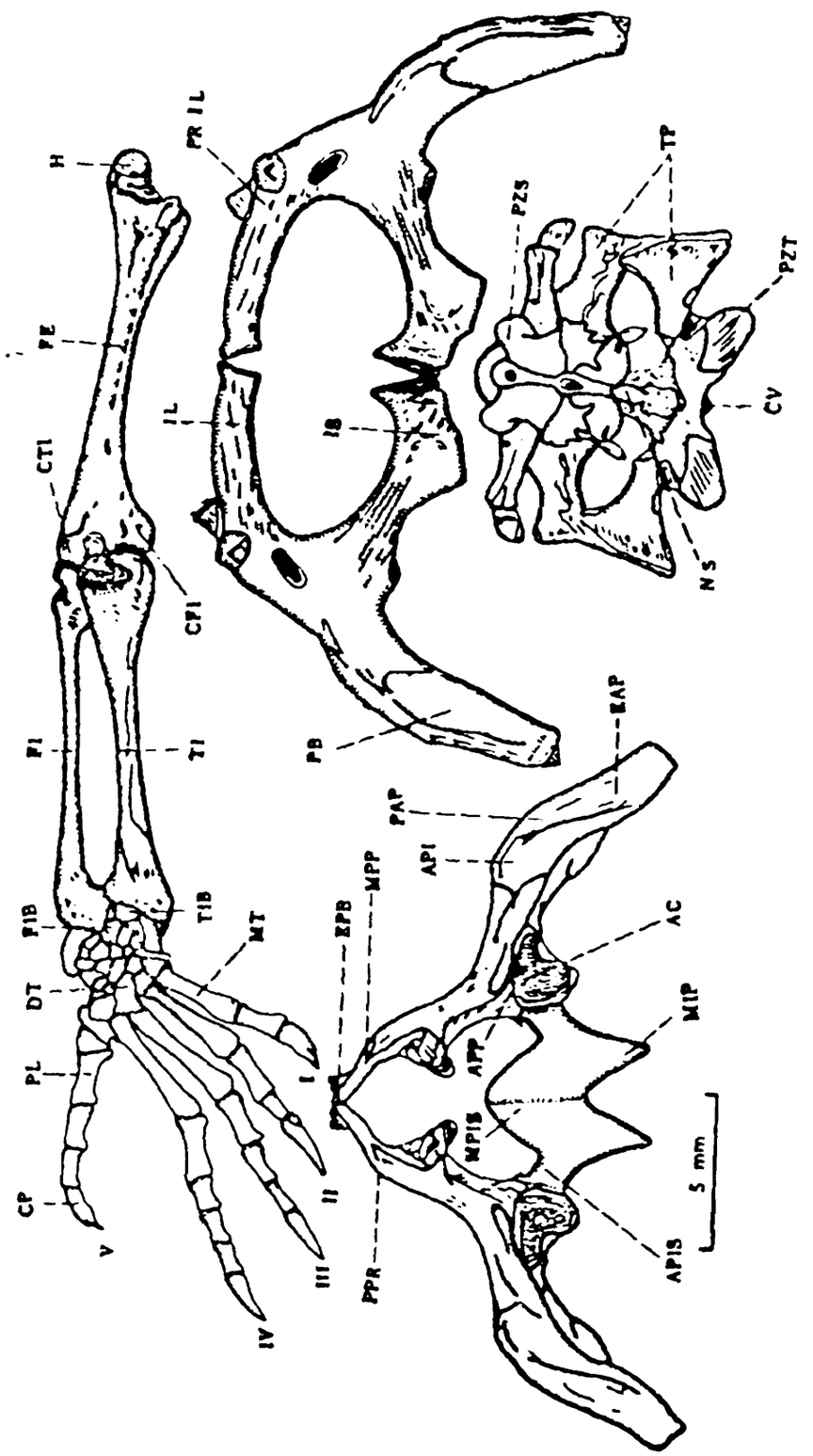

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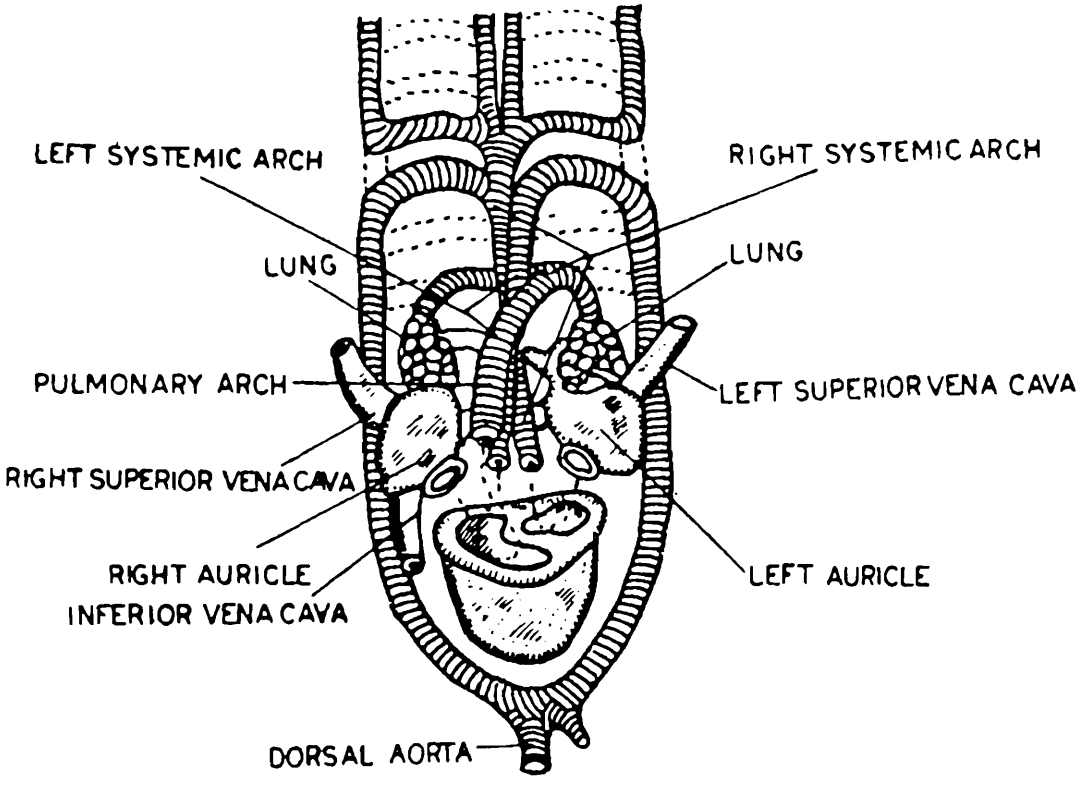
Fig. 35. Hindlimbs and pelvic girdle of a reptile



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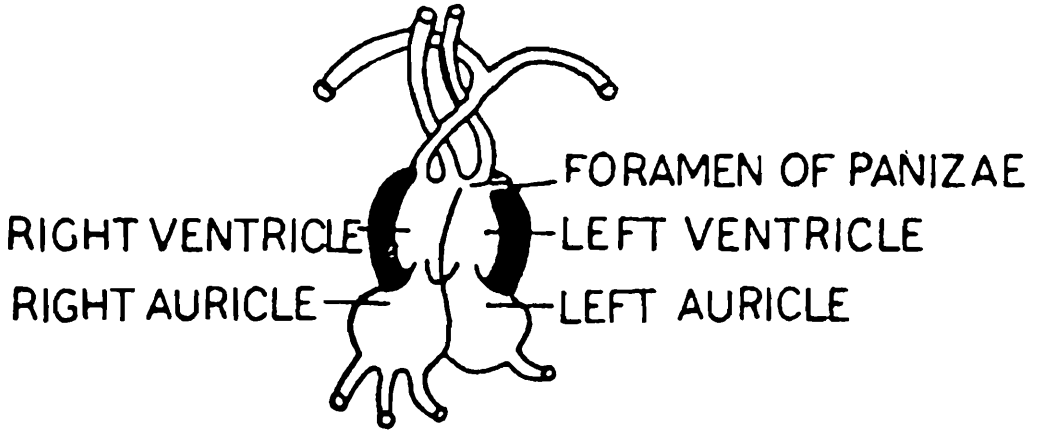

37

Fig. 36. Heart and aortic arches of a crocodile.
Fig. 37. Heart of a Crocodile.

The present reptiles represent only 4 of 15 main orders (which we have already discussed above are : Testudines (Turtles, Tortoises and Terrapins) 203, species; Crocodilians (Gharial, Crocodiles, Alligators and Caimans), 21 species; single species of Rhynchocephalia, and Squamatans, 6045 species (2773 species of lizards and 3272 species of snakes).

Order TESTUDINES Linnaeus 1758

1. Order Testudines :
   1788. Batsch, *Anleit, Kennt. Thiere, Mineral. i* : 437.
   1931. Smith, *Fauna Brit. Ind.* 49.
   1990. Marquez, *Sea turtles of the world*. FAO species Catalogue 125(11) : 1-81.
2. Order Chelonia :
   1802. Macartney, in Ross, Transl, Cuvier's List *Comp. Anat, i,* tab. iii.
   1890. Boulenger, *Fauna Brit. Ind.* : 6.
3. Order Testudinata :
   1811. Oppel, *Ordn. Rept.* 3.
   1836-42. Bell, *Monogr. Test.*
   1907. Stejneger, *Herpt. Japan.* 483.
   1909. Siebenrock, *Zool, Jahrb, Syst. Jena Suppl.* 10 : 432.

Testudines or chelonians are most primitive, typically clumsy and poikilothermous animals. They are mainly amphibious creatures and have adapted to various ways of life. Some live in freshwater some in muddy habitats while some have become terrestial and some have adapted themselves to marine way of life, leading a semi- pelagic life. Common turtles and tortoises are small to medium size reptiles ranging from 100 grams to a few kilograms in body weight but the giant sea turtles might attain a weight of many hundred kilograms. The largest and the most pelagic species among the living turtles these days is the huge Leather-back turtle (*Dermochelys coriacea*) which reaches a body weight of over 750 kg. These reptiles have a very long life span and the available records indicate that a giant tortoise *Geochelone gigentea* survived for 152 years in Seychelles Islands in the Indian Ocean, from 1766 to 1918.

Their body is well protected as it is enclosed in a box-like bony or leathery shell. The upper portion of the shell is the carapace and the lower one is the plastron. The carapace and plastron are generally composed partly of a modified inner layer of bony dermal plates and partly of a covering modified outer layer of horny scales, scutes or shields. The carapace is composed of a median series of plates comprising the anterior most large nuchal and eight neurals, a right and a left lateral series of eight costal plates and a series of marginals bordering the complete carapace. The nuchal shield is not united to the first dorsal vertebra immediately below them and one to three supracaudal shields. (Fig. 38) The coastals are firmly united with the ribs below them, and by their inner and outer extremities with the neural and marginal plates, respectively. The marginal plates are usually eleven on each side. The plastron is made up of nine bones, namely a pair of epiplastral, hyoplastral, hypoplastral, xiphiplastral plates and a median entoplastral shield. The epidermal shields of the turtle plastron

are comprising pairs of gular, humeral, axillary, pectoral, abdominal, inguinal, femoral and anal shields. The carapace and plastron are connected by a hinge at the sides. In the turtle species of families Dermochelyidae and Trionychidae the shell is covered by a leathery soft skin. All the species of Testudines are devoid of sternal ribs. The clavicles and interclavicles have been merged into the plastron. A major portion of the vertebral column and most of the ribs with capitular portion have fusè with the carapace. Dorsal ribs have fused laterally with the pleurals and only two sacral ribs remain free. Single headed ribs are present on the truck and sacral vertebrae. The ribs of the trunk except the first are fused to the carapace. The vertebrae are procoelous, amphicoelous or opisthocoelous. There is a remarkable and drastic reduction of the axian skeleton in the Testidunes. Out of the ten trunk vertebrae nine have bony attachment with the neural bones of the carapace. The cervical vertebrae form a complex articulation with the trunk vertebrae, except the first are immovably fixed by fusion of the neural arch with the carapace. The skull (Figs. 39-41) is most primitive like earliest cotylosaurian reptiles, typically anapsid and is devoid of rue temporal fossae and arches but the temporal region is usually emarginated. The chelonian skull is devoid of ectopterygoids, lachrymals, nasals and interparietals. The vomer is unpaired, the quadrate is fixed and absolutely immovable. A continuous hard palate forms the bony roofing of the mouth, thus separating the buccal and nasal cavities. The skull is thus having only a single nasal opening and is devoid of penial or parietal foramen in its mid-dorsal region. Jacobson's organ is not separated from the general nasal cavity. Teeth are not available in the living species except in the embryonic stage of the species of genus *Trionyx* (family Trionychidae). In most of the fossil forms from the Triassic period distinct teeth were present. Now-a-days in all the living species the teeth have been replaced by a strong, horny, bill-shaped structure bouding the margins of the jaws which are provided with a tough bony sheath. On Account of the fusion of the ribs and most of the truk vertebrae to the shell, the pectoral and pelvic girdles stay within the rib cage and the limbs emerge sideways from the anterior and posterior apertures of the shell. Openings for the head and tail are also left at the front and behind of the shell. The limbs are placed at the sides of the body with a short stride in walking. Limbs are typically pentadactyle and complete; the phalangeal formula is generally 2, 3, 3, 3, 3 and 2, 2, 2, 2. Elephantine hind limbs are a characteristic feature of the terrestrial species; webbed limbs are present in the fresh-water species and these are modified as filppers in the marine turtles. Eyelids are present and the pupil is round. Tympanum and columela auris are present. The neck is long, flexible and retractile. In all the Indian species the bending of the neck is verticle and enables the head and neck to be withdrawn for protection within the shell. The infra-ventral surface of the eight neck vertebrae are modified in such a way that they allow the neck to bend in two places in a verticle S-shape manner at the time of withdrawal. The cloacal opening is longitudinal and circular. The copulatory organ is a well developed unpaired structure which is retracted into the ventral sheath of the cloaca anterior to cloacal aperture. The lungs and other soft parts have been modified drastically in all the species of modern turtles and are dorsally situated, lying mmediately beneath the carapace

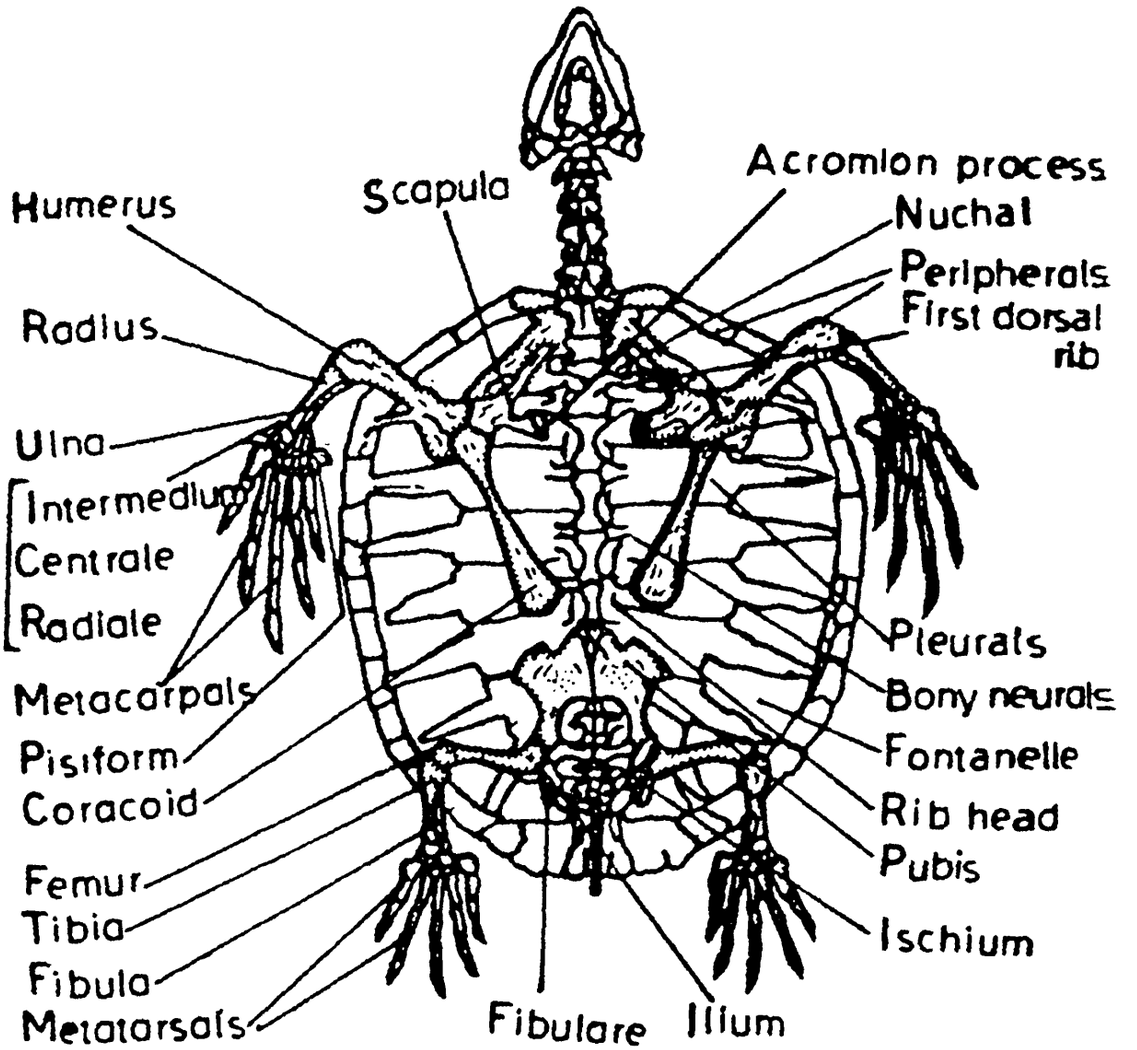

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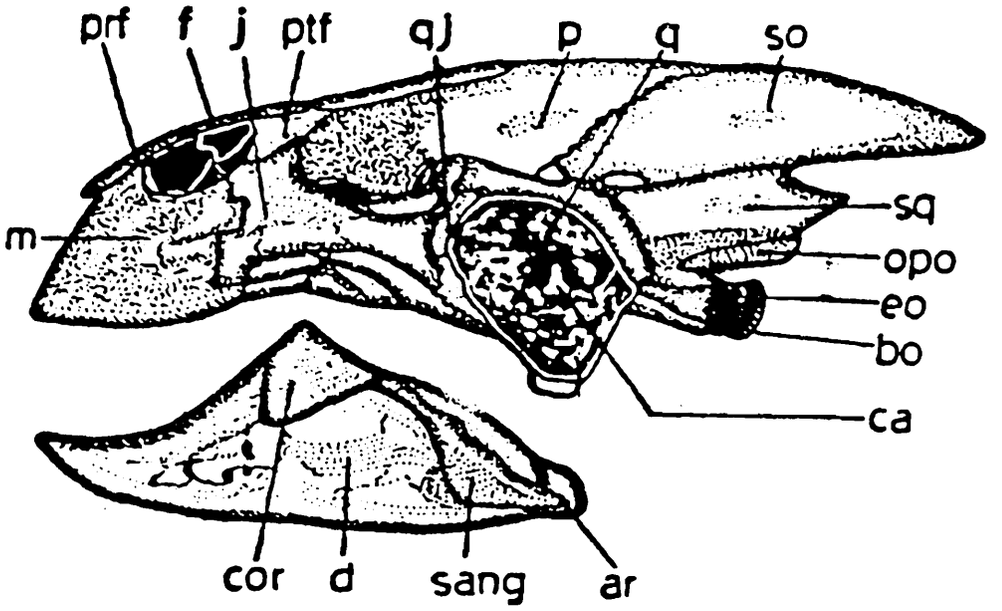
Fig. 38. Skeleton and carapace bones of *Eretmochelos imbricata*.



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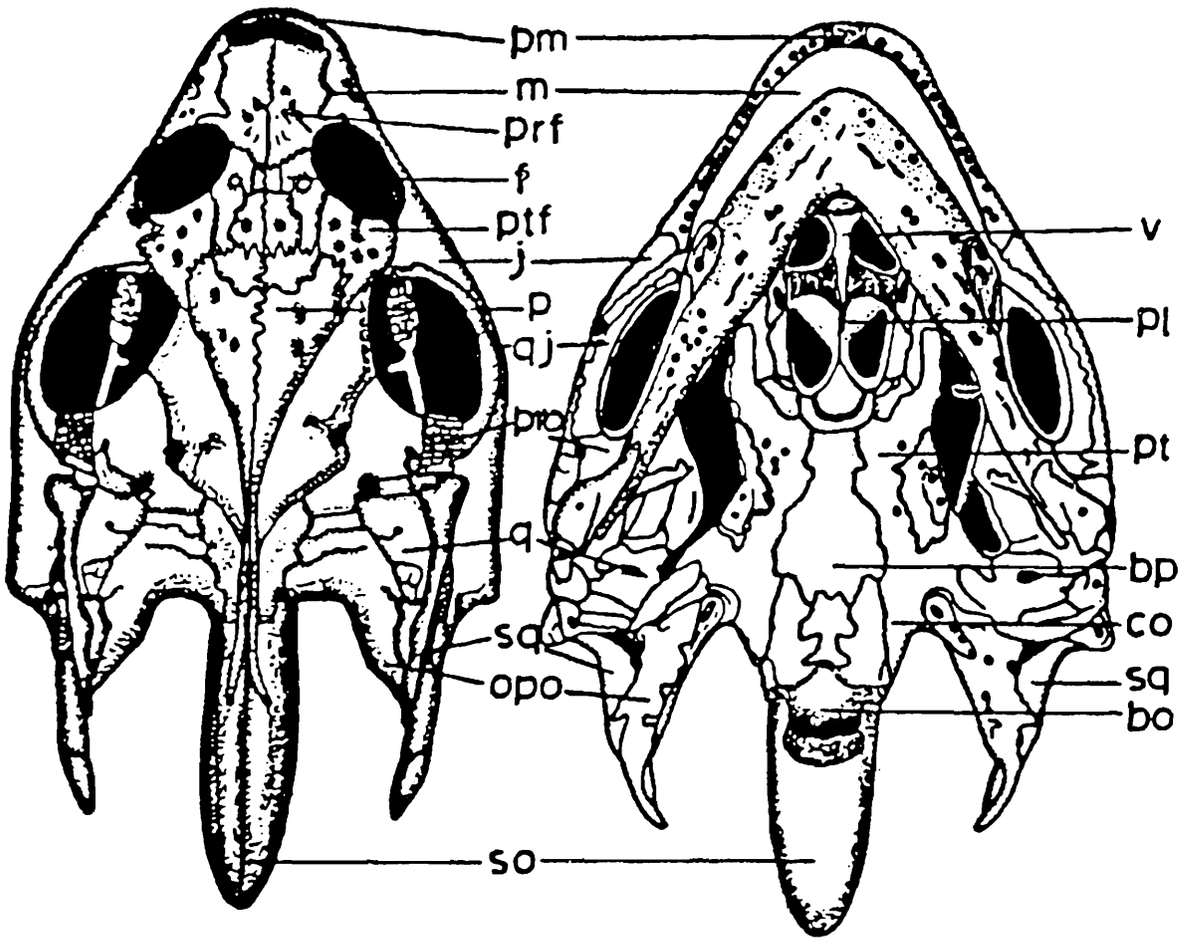


40 41

Fig. 39 – 41. Typical anaspid skull of Tersudines.
39. Lateral view. 40. Dorsal view. 41. Ventral view.

and are ventilated mainly by changes in pressure in the viscera. In all species speciall respiratory muscles are available in view of the enclosure of the body by the shell. In land tortoises breathing takes place by movements of the head, limbs, and abdominal muscles and the hyoid apparatus. Inspiration is brought about by the contraction of the oblique abdominal muscles at the hind leg pockets which expand the spongy lung cavities. Expiration is effected by the ventral abdominal muscles which push the viscera against the lungs and deflate them. In certain aquatic species the accessory respiration takes place by water circulating through the pharynx and the cloacal sacs. On account of these natural arrangements only, the turtles can live submerged for many days without suffocation. vision is well developed in all the species of chelonians and it is a matter of interest that some aquatic species are remarkably receptive to infra-red radiation. Organs of sense are quite specialized and are absolutely capable to judge any physical or chemical stimulation. The sense of smell is acute as the olfactory parts of the brain are considerably large. The sense of hearing is moderate and the ears are most effective within a narrow range of sound. In some species the ear drum is covered by ordinary skin. Males generally have longer nails on fore feet, longer preanal region and long, thick tails in comparision to the females. While compulating the male mounts the female back and coincides its cloacal region with that of the female. In aquatic species courtship and copulation occurs in water only. There is no viviparity and all the species are oviparious and lay cleidoic eggs. Eggs are round or oval, soft or hard-shelled, laid in a nest exacvated in the soil or sand. The number of eggs laid at a time varies from one to over 200 and some turtles lay several times in a year. Clutch size varies from 10 in some terrestrial species to hundreds in marine turtles. Parental care is not exhibited by any species at any stage in life. Hatchlings are provided with a horny curuncle on upper jaw for slitting the egg shell. Most of the species become sexually mature within ten years. The species found in India represent carnivorous, herbivorous and omnivorous forms. Six families, 23 genera and 51 species and subspecies are available within the limits of Indian Region.

MARINE TURTLES
(FAMILIES DERMOCHELYIDAE AND CHELONIIDAE)

Five species of sea turtles are available in the Indian waters : the Leatherback (*Dermochelys coriacea*), the Green Sea turtle (*Chelonia mydas*), the Hawksbill (*Eretmochelys imbricata*), the Loggerhead (*Caretta caretta*) and the Olive Ridley (*Lepidochelys olivacea*). The Leatherback is widely distributed in tropical seas and often visits temperate water zones also. The exact distribution in Indian water is not known and as the turtle is scarce everywhere the exact areas of origin are still unknown. The maximum concentration of the Leatherback in Indian Ocean has been recorded at the Gulf of Kutch, Okha coast, Goa coast, Tangasseri reef near Calicut, the Gulf of Mannar, the Palk Bay and in the coastal areas of Sri Lanka. The Green Sea Turtle is a circumstropical species which is widely distributed in tropical and subtropical seas and come ashore on particular beaches and nests in a colonial fashion. It is widely distributed in Indian waters and the maximum concentration of its population has

been recorded at the Sandspit and Hawks Bay, in Pakistan; Gulf of Kutch, Okha coast in Gujrat; coasts of Salm district in Maharashtra; along the entire Kerala coast extending south from Quilon; complete eastern coast of Tamil Nadu (Kanyakumari, Rameswaram, Tuticorn and adjoining islands, Point Calimere, Nallatanni Island); and in all coral reef areas in the Gulf of Manner and Palk Bay. The Hawksbill turtle also has almost a similar range of distribution as the Green Sea Turtle in tropical and subtropical seas but it is nowhere in abundance and prefers to lead an independent life, prepares scattered neasts individually in localities far apart, does not form breeding colonies and prefers to migrate short distances only. The maximum concentration of the Hawksbill is at the coastal parts of southern Tamil Nadu, Kerala, Andaman and Nicobar Islands, islands in the Gulf of Kutch, all coral reef areas in the Gulf of mannar, Palk Bay and Lakshadweep Islands. The Loggerhead Sea Turtle is the most widely distributed species in all the temperate and subtropical waters of the world. Most of the nesting zones of this turtle are either north of the Tropic of Cancer or south of the Tropic of Capricon. Loggerhead turtles are in the habit of migrating long distances and their nesting takes place in a colonial fashion, and the largest population of nesting females up to 30,000 per year has been reported from Masirah, Island near Oman. The exact nesting areas of the Loggerhead in India are not known but the maximum concentration of this turtle has been from southern Tamil Nadu coast and coral reef areas in the Gulf of Mannar and the Palk Bay. The Olive Ridley Turtle has a wider tropical range in India, East Pacific and Eastern Atlantic oceans. This turtle is most widely distributed in the Indian ocean and the maximum concentration has been recorded from the coastal areas of Maharashtra, Goa, Kerala, south Tamil Nadu, Andhra Pradesh, Orissa, Andaman Islands, Gulf of Mannar, southern coast of Sri Lanka, Lakshadweep Islands, Hawks Bay and Sandpit in Pakistan, Diamond Islands in Burma and southern Kelatan to Pahang in Malaysia.

FRESHWATER TORTOISE-TERRAPINS (FAMILY EMYDIDAE)

These are the hard-shelled, amphibious, herbivorous, or carnivorous and omnivorous chelonians, relatively of small size, inhabiting the various freshwater bodies of Northern Hemisphere. They are devoid of mesoplastron infralabials and gular shields. The are closely related to the hand tortoises, but can be differentiated by not having elephantine hind feet and are more adapted to freshwater life than to a terrestial one. The family Emydidae is well represented in Indian Region by ten genera, namely : *Pyxidea, Cyclemys, Cuora, Melanochelys, Heosemys, Geoclemys, Morenia, Hardella, Kachuga* and *Batagur*. The genus Cyclemys is widespread from Assam to the Philippines Islands through south-east Asia and is represented by two species, *Cyclemys dentata* and *C. annamensis. Cyclemys* is so close to *Heosemys* and *Melanochelys* that sometimes the validity of their generic distinction is doubted. *Melanochelys* includes two species of three-keeld, semi-aquatic forms, *M. tricarinata* and *M. trijuga*. The latter has six distinct subspecies in Indian Region, namely *M. trijuga trijuga, M. trijuga edeniana, M. tirjuga indopeninsularis, M. trijuga coronata, M. trijuga parkeri* and *M. trijuga thermalis.*

The fossil species of *Melanochelys* are from the Siwalik Hills. *Heosemys* is represented by three species *H. depressa* is restricted to Arakan in Burma, *H. grandis* is available in Burma, Thailand, Cambodia and Malaysia.

H. silvatica, which is quite a small, secretive and terrestrial turtle is endemic to India, inhabiting the dense rain forests of Kudamurutti, Idukki, Kavalai, Masanguddi and Chalakudi near Cochin in the Kerala State. *Geoclemys* is a monotypic genus inhabiting the Ganga and Sind river systems of India and Pakistan. The species *G. hamiltoni* is a moderately large, yellow and black, elegant species with a thick and strong tricarinate shell and large yellow spotted head with powerful crushing jaws. Fossil records of this species are reported from the Siwalik Hills. *Hardella* is also a monitypic genus and the species *H. thurgi* is a perfectly herbivorous, docile, large aquatic tortoise with a projecting, conical snout. It frequents the slow flowing and stagnant water of the Ganga and Brahmaputra river systems and makes nests on the suitable spots on the sandy river banks. Genus *Kachuga* comprises seven perfectly aquatic and generally herbivorous species out of which six, namely *K. smithi, K. tentoria, K. tecta, K. sylhetensis, K. dhongoka and K. kachuga*, are restricted to the Ganga, Brahmaputra, Mahanadi, Godavri and Krishna river systems of India; the Sind river system of Pakistan and also available in Nepal *K. trivittata* frequents the water of Irrawaddy and Salween river systems in Burma. Fossils of *Kachuga* have been obtained from the pleistocene deposits of Siwalik Hills and Narbada valley. Genus *Batagur* is represented bya single omnivorous, entirely aquatic and extremely shy species, *Batagur baska* which has a wide range of distribution from India (Bengal) to Sumatra through Burma, Malaysia and Vietnam. This species frequents the estuaries, deep slow running rivers away from tidal influence, freshwater lakes and canals.

BIG HEADED TURTLE
(FAMILY PLATYSTERNIDAE)

Single species *Platysternon megacephalum* represents the family. Three subspecies are recognised viz., *Platysternon megacephalum megacephalum* from southern China, *P. m. peguense* from southern Burma, Thailand and Indo-China and *P.m. vogeli* from Thailand.

THE LAND TORTOISES
(FAMILY TESTUDINIDAE)

These are the heavy-shelled, terrestrial and herbivorous forms with head and neck completely retractile within the shell; the temporal region is not roofed; the plastron is large without inframarginal plates in the plastral bridge and is completely devoid of any hinge. The carapace is strongly domed, rigid, covered with dermal shields showig the growth rings. The carapace and plastron are united by a broad bridge. These tortoises are having strong, unwebbed feet with comparatively short digits. The hind feet are club-shaped and elephantine. The skin of the anterior side of the fore-limbs is covered with strong horny scales. The family Testudinidae is represented in Indian Region by the two tortoise general *Geochelone* and *Testudo* which are widespread in tropical south-east Asia also. *G. elegans* has got a wide range of

distribution from Pakistan (Sind) to Sri Lanks through central and south India. *G. emys* is the largest of the Asiatic species of the genus *Geochelone*, inhabiting hillyareas of eastern India (Assam), Burma, Kampuchea, Laos, Malaysia Thailand, Vietnam and Indonesia (Sumatra and Borneo). *G. elongata* is quite abundant in the hilly areas throughout its range which extends from North-eastern India to Vietnam through Burma, Kampuchea, Laos, Malaysia and Thailand. *G. travancorica* which is closely allied to *G. elongata* is an endemic species inhabiting the hilly areas of Travancore-cochin, Mercara (Coorg) and western Ghats. There is every possibility that *G. elongata* and *G. travancorica* might have evolved from the same ancestral stock of tortoises which once flourished on the vast areas of India and Indochina in the Pliocene period. Leaving aside the differences in certain characters like nuchal shields and plastral sutures, both the species have a ramarkable similarity in coloration, size and habits. Plenty of fossil records of Indian Land tortoises have been obtained from the Siwalik Hills. *G. platynota* is a Burmese species. *G. impressa* is found in the hilly areas of Burma, Malaysia and Thailand. Genus *Testudo* is represented by *Testudo horsfieldi* which has got a wide distribution from North-west Pakistan to East of Caspian sea through Afganistan, Iran and USSR.

FRESHWATER AND MUD TURTLES (FAMILY TRIONYCHIDAE)

The group comprising the modern, flattened, softshelled, carnivorous, aquatic turtles and showing typical divergence are quite distincet from other crytodirans. Head and neck are completely retracted within the shell, the temporal region of the skull is not roofed; carapace covered with a leathery skin, scutes are replaced by a continuous layer of soft skin and peripheral bones are missing except in the genus *Lissemys* where they are replaced by the rudimentary bony structures; edges of carapace are generally composed of flexible cartilage and become ossified only in very large turtles; the shell is dorso-ventrally flattened, round or oval; the carapace has raised sculptures; the plastron is generally reduced and not joined to the carapace by a bridge; lateral and hinder portions of the dorsal disc are most flexible and the free rib ends are just embeded in the marginal cartilaginous mass of the shell; head is narrow, tympanum is hidden, snout elongated, tubular and is like a proboscis, neck is quite long, jaws are makedly sharp and are hidden below the soft lips; limbs are modified into swimming paddles, clawed and webbed.

Trionychid turtles are represented in Indian Region by five well established genera, namely *Lissemys, Pelochelys, Chitra, Dogania* and *Trionyx* inhabiting freshwater habitats like marshes, pools, lakes and rivers. Genus *Trionyx* is widely distributed in Asia, Africa and North America and is represented in India by three species namely *Trionyx gangeticus*, *Trionyx hurum* and *Trionyx leithi. T gangeticus* is available in Nepal foothills, Pakistan and India and considerable populations of the species are present in the Sind, Ganga and Mahanadi river systems. *T leithi* is available in the Ganga, Mahanadi, Godavri and Krishna river systems. *T hurum* frequents the lower reaches of the Ganga and Brahmaputra river systems. Lissemys is a monotypic genus inhabiting India and Burma The species *L. punctata*

includes three quite distinct subspecies. *Lissemys punctata* ranges in the Sind and Ganga river systems. *Lissemys punctata granosa* inhabits the rivers of Peninsular India and Sri Lanka. *Lissemys punctata scutata* frequents the Irrawaddy and Salween river systems of Burma. Genus *Chitra* is represented by a single species *Chitra indica* inhabiting the river systems of North India, Thailand, Malaysia, Pakistan and Nepal. Trionychid fossils of *Trionyx, Chitra* and *Lissemys* have been recorded from the Pliocene and Pleistocene deposits of the Siwalik Hills in India. *Pelochelys* is having only single species. *P. bibroni* which is the largest of the soft-shelled turtles which are with a short proboscis and rounded head. Dogania is represented by a single species *Dogania subplana* distributed in Burma, Thailand, Malaysia, Java, Sumatra, Borneo, Mergui Archipelago and off Tenasserim.

Suborder CRYPTODIRA Cope 1870

Key to the families

1. Digits elongated, flattened, and bound together; limbs paddle-shaped 2
   Digits not elongated, flattended, and bound together 3
2. Limbs paddle-shaped, clawless, feet scaleless; carapace covered with smooth skin, no eipdermal shields and with seven prominent longitudinal keels ..... DERMOCHELYIDAE
   Limbs paddle- shaped, with one or two claws, feet covered with scales; carapace covered with epidermal horny shields ..... CHELONIIDAE
   Limbs not paddle-shaped, digits prominent, with four or five claws; carapace covered with epidermal horny shields ..... PLATYSTERNIDAE
3. Forelimbs semi-paddle shaped with three claws; carapace covered with smooth skin; edge of carapace flexible ..... TRIONYCHIDAE
4. Limbs paddle-shaped but more or less flattened; digits webbed; top of head covered with smooth skin or with the posterior part of it divided into shields; claws 4-5; carapace covered with horny shields or its skin bears many projections giving it a roughened appearance ..... EMYDIDAE
   Limbs more or less cylindrical, the hind limbs clubshaped or elephantine, digits not webbed; upper portion of the head shielded; plastron with 12 shields, pectoral shield forming fron part of bridge ..... TESTUDINIDAE

Family I. CHELONIIDAE Gray 1825

1825 Cheloniadae and Carettidae, Gray Ann. phil (2) X. 212.

This family comprises marine turles whose carapace and plastron covered with horny epidermal shields. The neck in these is incompletely retractile and bends in a sigmoid curve almost in vertical plane; cervical vertibrae much reduced in length; outer margin of tympanic cavity is notched; pterygoids articulate medinally; squamosal forms a suture with the parietal. Pelvic girdle not anchylosed to the shield. Legs are modified to form swimming paddles; feet are covered with scales, the digits of the fore-limb are much elongated and phalanges noncondylar. Claws are one or two. Skull roof and bony shell is incomplete. Nuchal shield is devoid of costiform process. Plastron is composed of nine bones and its elements are remarkabley reduced

in size, a median vacuity is always present between the two lateral halves. all the parts of plastron are connected ligamentously to the carapace. The other characterstic features of the family are the complete and perfect roofing of the temporal region; downward prolongation of the parietals; incomplete costal plates at the periophery; presence of forntanelles between the costalplates and the marginal bones. The Indian species of family cheloniidae are included in four monotypic, cosmoplitan genera with a wide distribution in tropical and sub-tropical seas, and casually visit to the coasts to certain temporate zones of the world. The Sea Turtles lead a perfect aquatic life and visit the sandy coastal areas of the land only during the breeding season.

Key to the Genera

1. Costal shields four on each side; one pair of prefrontals between the eye; horny scutes juxtaposed not over lapping (imbricated); horny edge of lower jaw strongly dentate; bony alveolar surface of upper jaw having low but regularly raised ridge; jaws not hooked; single claw is present of each flipper carapace greenish with violet marking; skin on neck yellow or creamish ..... ***Chelonia***
   Costal shields 4-9 on each side; 2 pairs of prefrontals between the eye; horny edge of lower jaw smooth or feebly dentate; bony alveolar surface of upper jaw smooth or with a sharp crestep ridge 2
2. Costal shields 4 on each side; horny scutes imbricated; two pairs of preforntal scutes; nuchal not in contact with the first costal on each side; snout elongate, narrow; premaxilla deeply excavated and not toothed terminally; alveolar surface of upper jaw with a single sharp-crested ridge; jaws are hooked; 2 claws are present on each flipper; Carapace is brown with deep brown makings; neck is light orange ..... ***Eretmochelys***
   Costal shields 5 or more on each side, not imbricate; nuchal in contract with first costal on each side; not imbricate; snout comparatively short and broad; pre-maxilla toothed; bony alveolar surface of upper jaw smooth or with a reunded ridge 3
3. Costal shields 5-9 (generally to 6 to 7) on each side; plastron with 4 pairs or inframarginals on bridge; each inframarginal is provided with pores on the hinder margin; maxillae separated by vomer, single claw is present on each flipper. Dorsal colour grey and plastorn yelow) ..... ***Lepedochelys***
   Costal shields 5 on each side; plastron with 3 pairs of inframarginals on bridge, pores are not present on the hinder margin of inframarginals; dorsal shields are juxtaposed; maxillae in contact with each other; colour brown or reddish brown, carapace browinsh-red with light spots and plastorn is yellow with orange spots ..... ***Caretta***

Genus 1. ***Caretta*** Rafinesque 1814

1814. *Caretta*, Rafinesque, *Specchio Sci. Palermo.* 2 (9) : 66. (type Caretta nasutus)

1835. *Thalassochelys*, Fitzinger *Ann. wien. Mus.* i, 121 (type Testudo caouana)

1890. *Thalassochelys*, Boulenger, Fauna Brit. Ind. 50

1931. *Caretta*, Smith, Fauna Brit. Ind. 1 : 70-72.

Carapace elongate, heart-shaped, with 5 costal shields on each side, the first costal touches the precentral scale; plastron with 3 pairs of inframarginals on bridge, pores are not present on the hinder margin of inframarginals; carapace shields are juxtaposed, thick and rough; Mazillae in contact with one another; head comparatively large, upper jaw strongly hooked; two claws are present on each flipper. Body colour brown or reddish brown, carapace brownish red with light spots, plastron is yellow or yellowish-brown with brown spots.

LOGGERHEAD SEA TURTLE

1. *Caretta caretta* (Linnaeus 1758)

(Figs. 42, 43, 44, 48 & 53)

1758. *Testudo caretta* Linnaeus, Abhenication should the used *Systema Nature*, ed. 10, T.I. : 197 (type loc. Islands of America).

1931. *Caretta Caretta* Smith, *Fauna Brit. Ind.* 1 : 71.

The Loggerhead Sea Turtle is a large, consmopolitan species with somewhat elongate carapace. The species gets its name from its big head, which in an old adult turtle reaches up to 30 centimeters in length and is one of the largest amongst all other sea turtles. The large head suitably accommodates massive jaw-closing muscles. It had been recorded that a large, fully adult Loggerhead may atain a length of 2.7 metres and weight 385 kilograms. According to the TUCN Red Data Book the maximum recorded length of the carapace is 114 centimetres, and the weight of a mature specimen ranges between 91-152 kilograms. The turtle has a pronounced beak and large brown eyes. The carapae (Fig 42) is more or less serrated posteriorly; costal scutes are generally 5 on each side; neural or central scutes are 5 or more; marginal shields are 27 (including 1 percentral or nuchal and a pair of postcentral or supracaudal scutes) and the mid-marginals are compratively wide.

The number of costal and neural shields of carapace is variable. The plastron (Fig. 43) consists of paired gular, humeral, pectoral, abdominal, femoral and anal shields; intergular which may be single, double or even absent, and inframarginals are in 3 pairs, enlarged and devoid of pores on the hinder magin. The dorsal shields are juxtaposed. Maxillae are in contact with each other. Head (Figs. 44-47) is covered with symmetrical shields and two pairs of prefrontals are present. A dorsal keel is present in small young individuals which becomes inconspicuous in large, aged adults. Two claws are present on each flipper. Tail is extremely short in comparison to the body. General colouration is brown or red-brown; carapace is brownish-red with light spots; eyes are brown and the flippes are greybrown.

Distribution : Loggerhead Sea Turtle is found in all the temperate and sub-tropical oceans of the world. Generally the nesting zones are either north of the Tropic of Cancer or south of the Tropic of Capricorn. These turtles have been recorded from the waters of Burma, India, Sri Lanka, Pakistan, Maldives, West coast of Sumatra, coasts of Southern China and Taiwan.

Habits and habitat : Nesting is seasonal and generally the nests are constructed during the night. The resting season of this circumglobal species ranges from May-January. At Kwa-Zula area on the Tongaland Coast of South Africa the nesting of Loggerheads takes place between November to January while at Florida and South Carolina, U.S.A., nests are made from May-August. When coming ashore to nest, female Loggerheads move magnificently in slow strides by using their flippes in a typical four-legged manner. With the help of hind flippers she digs a shallow nest pit and the round eggs, slightly smaller than a ping pong ball with a diameter between 40-42 mm. are deposited, 12 to 56 cm. deep in the sand. Clutch size varies rom 60-200. After the egg laying, the female covers the nest with sand and roughs up the surface of the beach over a wide area in order to hide the exact spot of the nesting. The incubation takes 55 to 66 days. Females may nest 4-5 times in one season but a single female can make a maximum of 7 nests. It has been recorded that the hatchling output per season per female is not more than 200. Loggerheads mature in 10-15 years. Female Loggerheads can re- migrate at 2-3 year intervals, most females tagged on the nesting beach are never seen nesting in anther season. The hatchlings spend the first few months of life while hiding under the layers of cetain weeds and feed mainly on small prawns, fish and crustaceans. The adult Loggerheads are fully carnivorous, feeding mainly on benthic invertebrates like molluscs, crustaceans, sponges, jellyfish, crabs, fish, seaurchins and starfish.

Status : The Loggerhead Turtle has become extremely vulnerable and is hunted in may countries for eggs, flesh and tourist curios. The main treats to survival are incidental capiture in trawls, loss of nesting habitat due to the urbanisation of the coastal areas, tourist pressure and local exploitation. Artificial lights are said to be responsible in causing dis-orientation of nesting females and hatchlings. Electric and other such lights attract them towards the inland roads and many females and hatchlings are killed by trafic accidents and dessication. Exploitation for meat, eggs and for making local curios is carried out in Mexico, Azores, Madeira, Canary Islands, Cuba, Mozambique, Dominican Republic, India, China, Japan and Columbia. At various industrially developed places of the world the numerous hatchlings of this species are killed by the chocking of jaws and throat by tar, mineral oil and by the various chemicals which accumulate in sea water as industrial waste or by any other method. Racoons are the strong predators on Loggerhead eggs in North America.

All over the world the status of the Loggerhead has been estimated mainly on the basis of nesting female population on the beaches. So far the routes of migration of the species, the exact habitats of hatchlings and their mortality rate, exact feeding grounds, methods for the estimation of the male population (males never leave water) are not known. Loggerhead populations is under enormous pressure and their number has alarmingly deelined in Honduras, Mexico and Columbia.

Conservation : All over its range, the species is nominally protected by legislation. Any type of commercial exploitation of turtles, hunting and egg collection is absolutely banned or allowed only in a limited way. Many countries like U.S.A. have established restricted fishery zones in order to avoid the incidental catch of Loggerheads, Various beaches throughout the world have been declared protected to conserve the nesting

or breeding turtles. The Loggerhead Turtle is listed on Appendix 1 of the Convention on International Trade in Endangered species of Wild Fauna and Flora (CITES) according to which any international trade concerning the species and its products and any sort of commercial exploitation is strictly prohibited. It has been proposed all over the world that the existing legislation should be enforced more strictly for the protection of these turtles at major nesting zones such as at Masirah Island, Oman. Places like Madagascar should be provided, all the possible help to re- establish their turtle reserves. The nesting beaches and other such areas should be made restricted fishing zones all over the world. There should be international co-ordinated programmes for the conservation of nesting, feeding and migratory areas of Loggerheads.

Captive Breeding : It is carried out at Seafloor Aquarium at Nassau, where a full breeding cycle has occurred.

Genus 2. ***Chelonia*** Brongniart 1800

1800. *Chelonia*, Brongniart, *Bull. Sci. Soc. Philom. Paris*, **2** : 89

1801. *Chelonia*, Latreille, *Hist. Nat. Rept.*, 1 : 22 (type *Chelonia mydas*)

1838. *Mydas*, Coeteau, in Sagra's *Hist. Fis. Pol. Nat. Cuba*, **4** : 22 (*Mydas mydas*).

1890. *Chelone*, Boulenger, *Fauna Brit. Ind.* : 48

1908. *Natator*, MC Culloch, *Rec. Austr. Mus.* **7** : 126 (type *Natator tessellatus*)

1931. *Chelonia*, Smith, *Fauna Brit. Ind.* 1 : 69.

Carapace almost oval, with 4 costal shields on each side; one pair of prefrontal shields between the eye; carapace shields are horny and juxtaposed but not overlapping or imbricate; head is blunt, not narrow but snout is not well demarkated and short; generally 4 post orbital scales are present; edge of lower jaw is horny and strongly dentate; bony alveolar surface of upper jaw having low but regularly raised ridge; jaws not hooked; single claw is present on each flipper; carapace in adult is greenish, with violet markings and skin on neck is yellow or creamish.

GREEN SEA TURTLE
2. ***Chelonia mydas*** (Linnaeus 1758)
(Figs. 45, 49, 54, 58- 61)

1758. *Systema nature* Linnaeus, Ed. 10, T, 1 : 197 (type loc. Ascension island; Mus. Upsala)

1787. *Testudo japonica*, Thunberg, *Seven vet. Akad. Handl.*. 8 : 178, pl. 7 (type loc. Japan).

1820. *Caretta thumbergii*, *Merrem, Syst. Amphib.* 19 (type loc. Japan).

1880. *Chelonia depressa*, Garman, *Bull. Mus. Comp. Zool.* **6** : 124 (type loc. East Indies & North Australia; Harvard Mus. Comp. Zool.)

1908. *Natator tessellatus*, Mc Culloch, *Rec. Austr, Mus.* **7** : 126 pls. xxvi & xxvii (type loc. Port Darwin; Austral. Mus. Sydney)

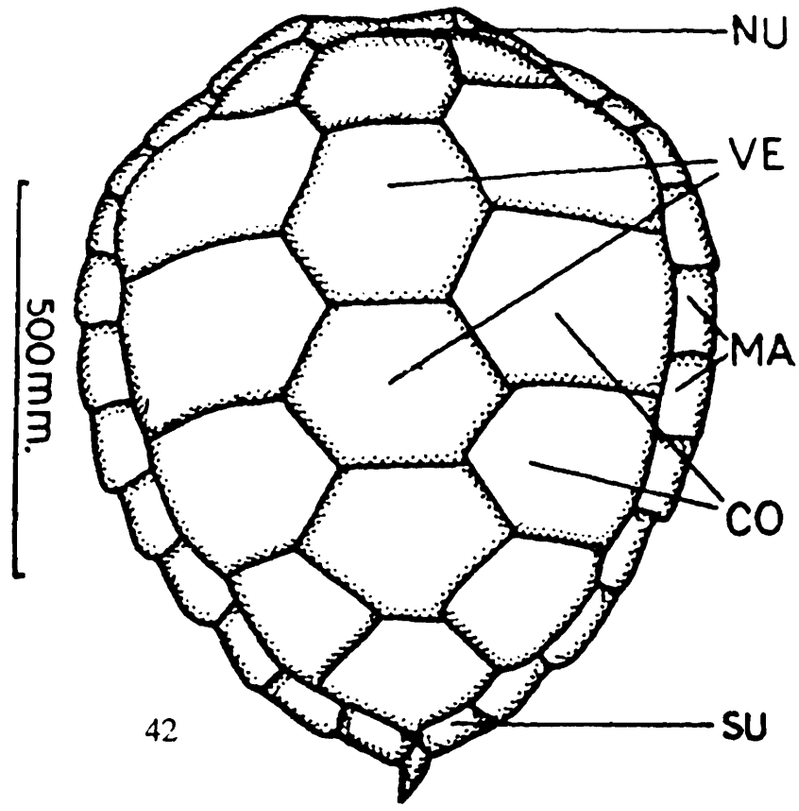
1930. *Chelonia mydas*, Smith, Fauna Brit. India 1 : 70

The Green Sea Turtle is the largest of the hard-shelled species of marine turtles, having market variations in size, weight and carapace shape between its different

populations all over the world. The name comes from the colour of its green fatty tissues. Its body is smooth, flat, streamlined and heart-shaped. A fully grown adult attains a carapace length up to 155 cm. (average length varies between 100-155 cm.) and normally attains a weight of 135-175 kg; the heaviest recorded is of 425 kg. The head is round and small in comparison to the body, the snout is short and jawa are not hooked. The horny sheath of upper jaw is with feeble, and the lower jaw with strong denticulations at the edges; two prominent and strong denticulated ridges are present on the alveolar surface of upper jaw; symphysis of the lower jaw is short and there is one pair of prefrontal shields. Carapace (Fig. 61) is not ossified completely; feebly unicarinate in the young, occasionally with feeble keels on the lateral aspects, arched in fully grown adults and feebly serrated or smooth posteriorly. Dorsal shields are juxtaposed; costal scutes 4 on each side; neural or central scutes 5; marginal shields 25 (including one small precentral or prenuchal and a pair of post- central or supracaudal scutes. The plastron (Fig. 62) consists of paired gular, humeral, pectoral, abdominal, femoral and anal shields; single intergular shield and a series of inframarginal shields. Head is covered with symmetrical shields and one pair of prefrontal shields present. Neither the head nor legs can be pulled under the shell the flipper are long and each is provided with a single claw. Tail is quite short in comparison to the body. The carapace is dark blue-black in the hatchlings, and green, olive, brown, buff or black in adults. Flippers are gray- green; the colour of head and flippers is generally like that of the shell of the individual turtle but the edges of the head scales are pale in most cases. In very old adults the shell becomes brownish. Semiadult turtles are most attractive and are called sunrays because of the beautiful brown and yellow shades on the dorsal shield. Limbs are yellow with a lare, dark patch on each hand and foot. Ventrum is yellowish.

Distribution : The Green Sea Turtle is a circumtropical species, nesting mainly in tropical and sub-tropical zones of the world. The species is generally distributed throughout Indian and Indo-Chinese waters. It is estimated that 200 females nest every year in India. Roughly between 3000-5000 Green Sea Turtles are being caught annually from Pamban, Cape Comorin, Rameshwaram and Mimisal coasts of India. Along the Puri coast of Orissa, 4050 Green Turtles are caught daily. These turtles are also available in the vicinity of Andaman Islands.

Habits and Habitat : The Green Sea Turtle frequents inshore waters, less than 25 metres in depth and sheltered by reefs. Remote islands are the most favoured nesting sites, though mainland beaches are also used. Suitable sandy beaches are used for breeding. The mating season is from May to July. Female turtless usually congregate in large numbers on such beaches mainly between June and November to lay eggs. In the summer moonlight, the huge female turtle heaves itself into the shallows at high tide. Then with strenumous movements of its flippers hauls itself up the shelving beach, sometimes over the rocky areas. Ultimately it reaches the dunes above the high-tide mark and actual egg laying commences. The pit of the nest is dug with sweeps of the front flippers and is generally more than a metre across and 60 centimetres deep. Then with the help of her hind flippers, the turtle digs an egg pit roughly about 45 centimetres deep and 25 centimetres across. Then egg laying starts during the early part of the night and within 15 minutes the pit is filled with



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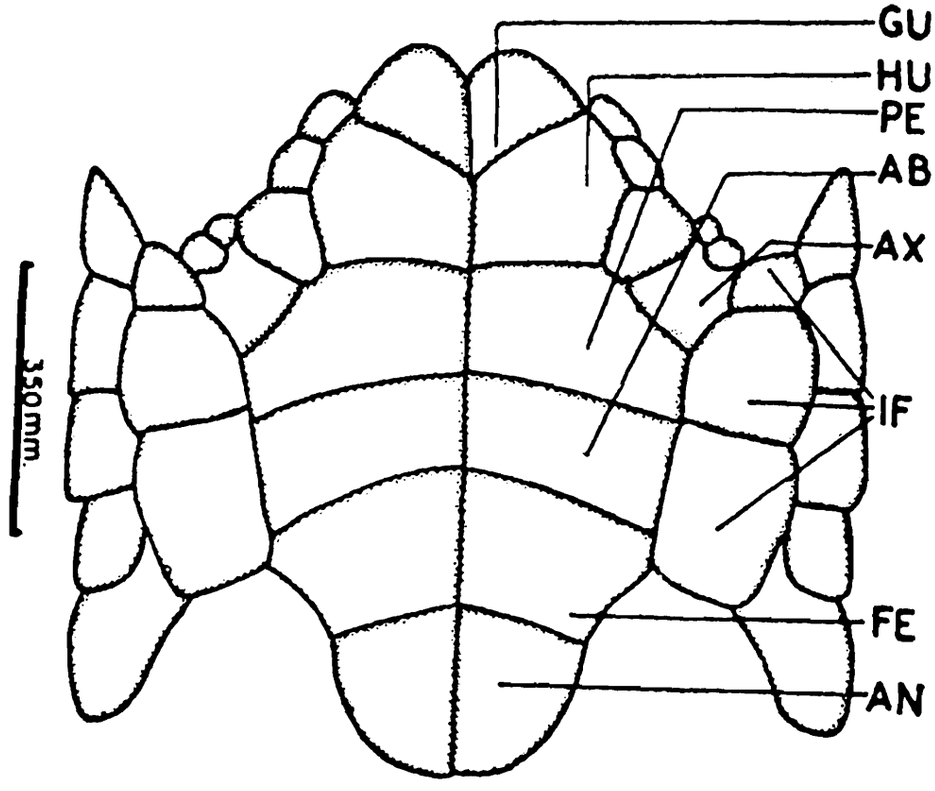

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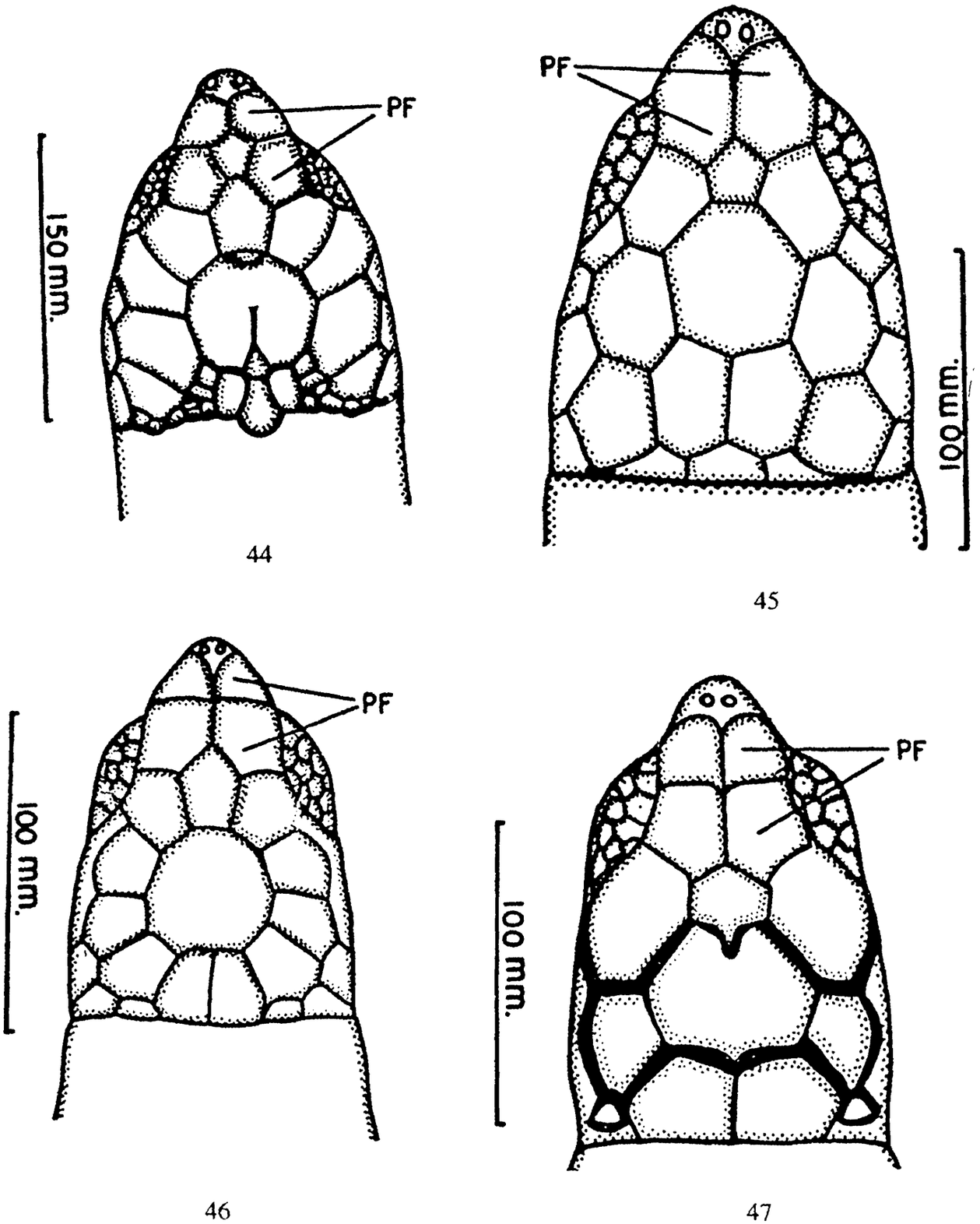
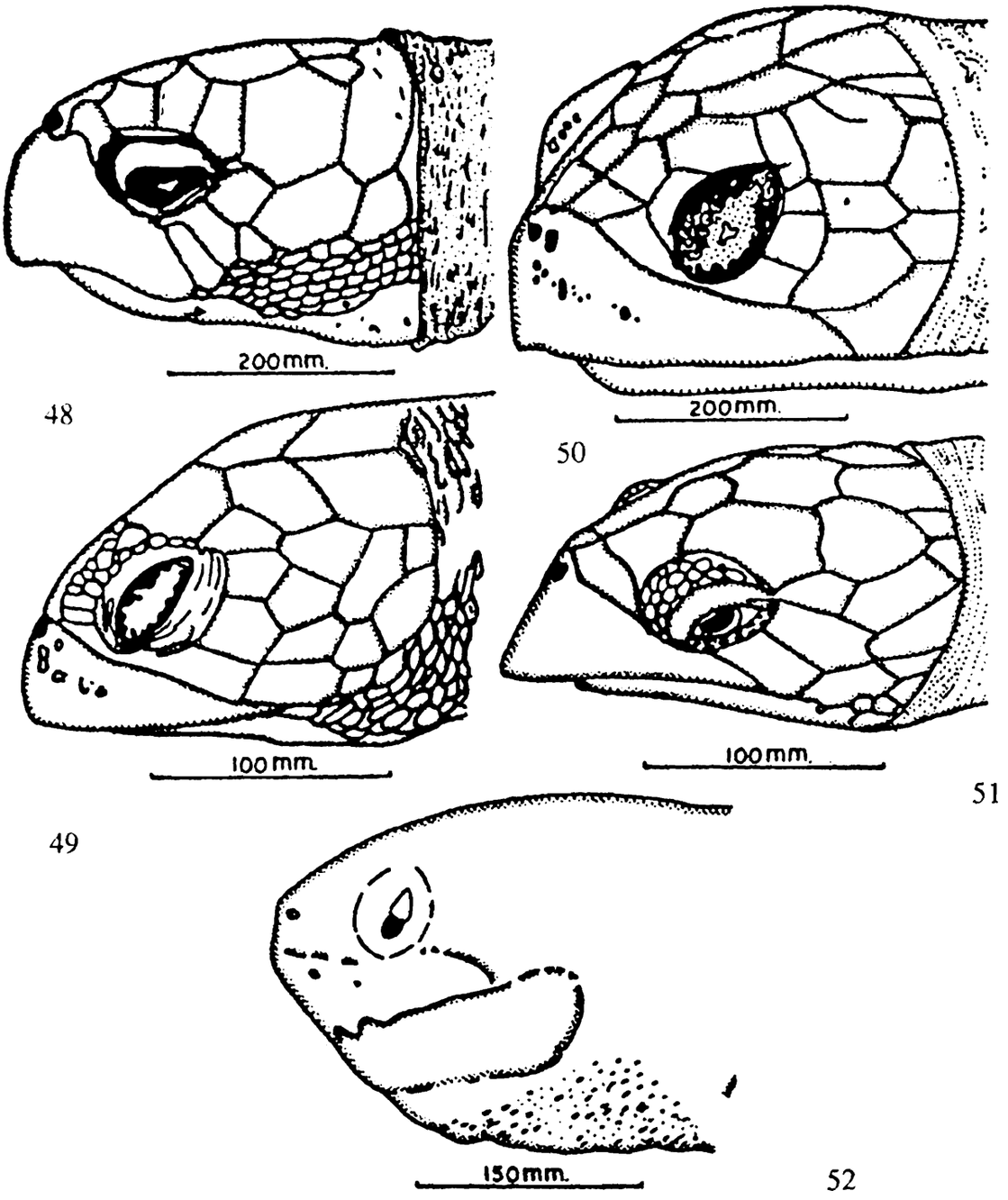
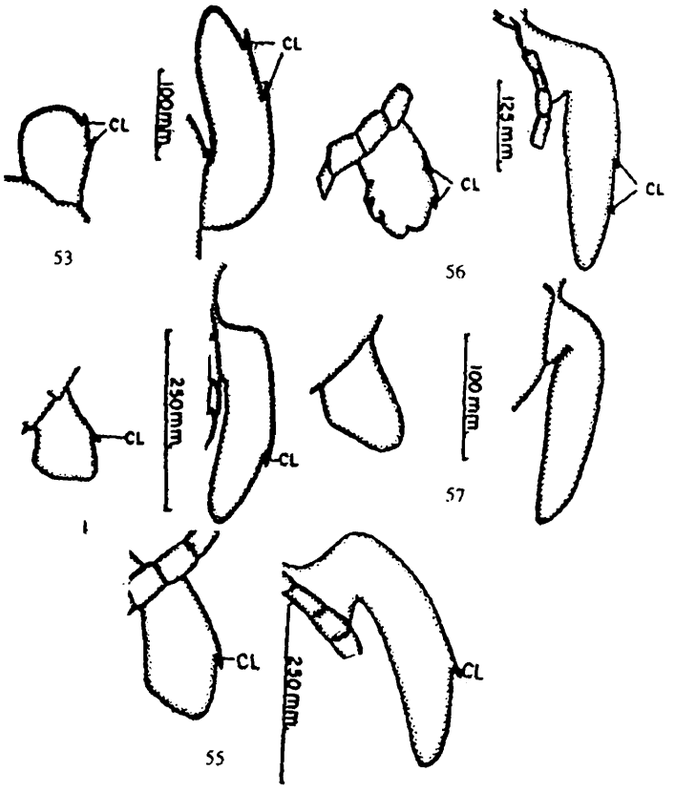
Fig. 42. Carapace of *Caretta caretta* (Linnaeus).
Fig. 43. Plastron of *Caretta caretta* (Linnaeus).

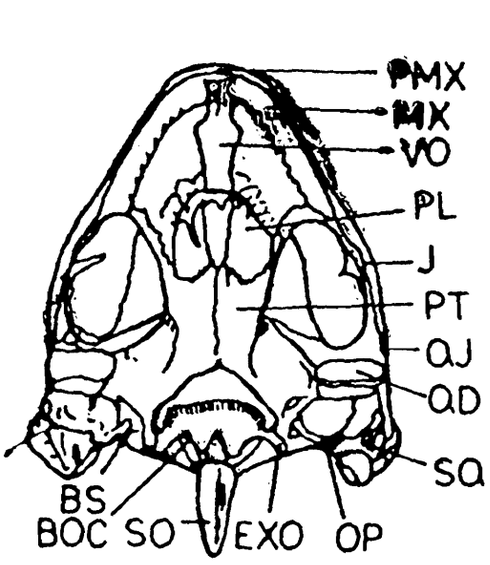


Figs. 44 – 47. Dorsal view of head in Marine turtles showing the Prefrontal (PF) and other shields : 44. *Caretta Caretta* (Linnaeus); 45. *Chelonia mydas* (Linnaeus); 46. *Lepidochelys olivacea*; 47. *Eretmochelys imbricata* (Linnaeus).



Figs. 48–52 Lateral view of head in Marine turtles. 48. *Caretta caretta* (Linnaeus) – showing the hooked jaws and head shields. 49. *Chelonia mydas* (Linnaeus) – showing the short snout and head shields. 50. *Lepidochelys olivacea* (Eschscholtz) – showing the narrow and small snout and head shields. 51. *Eretmochelys imbricata* (Linnaeus) – showing the compressed Hawk's like snout and head shields. 52. *Dermochelys coriacea* (Linnaeus) – showing the blunt snout.





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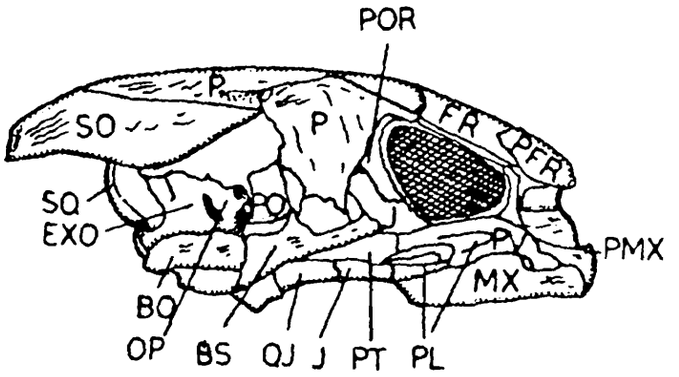

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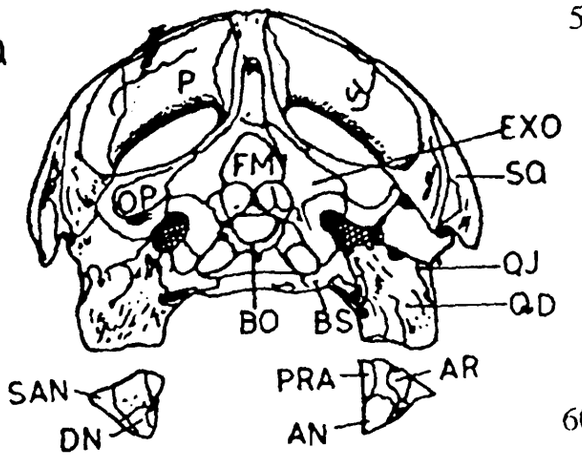

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Figs. 53 – 57. Fore (Large) and hind (Small) flippers or swimming paddles of Marine turtles showing the general shape and claws. 53. *Caretta caretta* (Linnaeus); 54. *Chelonia mydas* (Linnaeus); 55. *Lepidochelys olivacea* (Eschscholtz); 56. *Eretmochelys imbricata* (Linnaeus); 57. *Dermochelys coriacea* (Linnaeus)

Figs. 58 – 60.. Skull : *Chelonia mydas*. 58. Ventral view; 59. Lateral view; 60. Occipital region.

the white eggs about the size of ping pong balls and roughly with a diameter of 45 mm. The skin of the egg is not fragile but is tough and elastic. Each breeding female of Green Sea Turtle is estimated to lay between 350 and 600 eggs per year. The average cluth size is 10. Each female lays several clutches at an interval of 15 days, but will have a nesting season only after 3 years. The average temperature of the egg pit remains generally between 25°-30°C. The mothe turtle finally covers up the egg pit carefully with her hind flippers and fills in the body pit faster with her front flippers. She moves forward 3 or 4 metres on all sides in order to hide the exact site of the egg pit. After the completion of this egg laying process she heads back to the sea, moving much faster downslope than she went up. The incubation period varies between 40-91 days. Immediately after hatching the young ones dash towards the sea, guided by the brighter horizon. On the way up to the sea and after reaching the water, large number of hatchlings are killed and devoured by predators like crabs and fish. Nesting takes place all the year around with some strong seasonal peaks at various nest sites in the Indian Ocean and South-east Asia but is strictly seasonal elsewhere in the Caribbean, South Atlantic and Pacific Occeasn. The mature females nest on fairly regular cycles of two to four years intervals. In the wild state Green Sea Turtle becomes sexually mature between 15-20 years of age. Female turtles re-migrate at an interval of 2-4 years. After entering the sea, hatchlings pass 7-14 months at certain unknown places while drifting passively with pelagic algal mats and Sargassum grass. After passing this period, which is called as 'lost year', young turtles of 20-30 cm. length, initially migrate to the various inshore estuarine, coastal and reef-system habitats. The species migrates very long distances for food and egg laying. The normal mode of progression both in water and on land involves simultaneous sweeps by the front flippers. The adult Green Sea Turtle is entirely herbivorous and feeds on submerged marine algae, sea-weeds and grasses. The distribution of the Green Sea Turtle coincides quite closely with the distribution of sea grass pastures. The sea grasses which are consumed by these turtless are *Thalassia testudinum, Halodule* spp., *Syringodium* spp., *Cymodocea, Halpphila, Posidonia* and *Zostera*. Turtles select fresh green growth of the tender leaves of these grasses for feeding. In many areas of the range turtles consume red, green and other algae like *Hypnea* spp., *Caulerpa* spp. *Codium* spp. and *Ulya* spp. Hatchlings are mainly carnivorous and devour molluscs, crustaceans, and fish.

Status : This extremely migratory turtle has become quite endangered and its population has alarmingly dwindled throughout the world. Green Sea Turtle is heavily exploited and there is a large scale international trade for its flesh, cartilage, oil and eggs for food; stuffed adults, hatchlings, very young turtles, hide, skin and shell carving are used for curios and for making various commercial products. This turtle is an important food source of peopld inhabiting the sea-shores and island.

Its cartilage is processed to make turtle soup, which is regarded asa delicacy.

While nesting both males and females occupy a narrow zone of 4-8 km. from the shore for the entire breeding season and as such become quite vulnerable. Adult females and their eggs are readily taken by man and other predators during nesting and egg laying. A large number of turtle hatchlings perish due to different pollutants

which accumulate in the *Sargassum* weed mats by the local water currents of the sea. These weed lines (as already indicated above) provide the main shelter to the turtle hatchlings for the first year of their life. At this stage these turtles are voracious feeders and devour indiscriminately anything which comes across. As such they also consume accumulated oil particles, styrofoam, tar and numerous such chemical byproducts of the oil industry. The stress on the Green Turtle population can be very well judged by estimation of their egg laying at Sarawak during the last 55 years. In the year 1930 about 2,000,000 eggs were laid but the number gradually declined to 300,000 eggs only in the year 1970. the highest mortality of Green Sea turtle on account of incidental catch or trapping by shrimp trawls has been recorded from Australia Colombia, Equador, the Guianas, Malaysia, Peru and Pacific Central America.

Conservation : All over its range the species is partially or totally protected by law. Societies have been set up all over the world to protect this turtle and its nesting grounds. These societies are also engaged in hatching the turtle eggs by artificial incubation, and ultimately relasing the hatchlings to the natural habitat. These turtles enjoy total or partial protection at various nesting beaches which fall within National Parks and National Reserves. Some of these are Costa Rica : Tortugrero beach; Surinam; Galibi Sanctuary; Panama : Chirique Province Reserve; Venezuela : Aves Island; Reunion Dependencies; Nature Reserve of Europa, Tromelin, Les Glorieuses and Jaun do Nova; aldabra Nature Reserve; Australia: rookeries in National Park, Queensland, Lady Musgrove, Fairfax, Hoskyn, Heron and Bush Islands, Cape Range National Park, Bernier, Borre Islands, Barrow Island and Lacepede Islands Nature Reserves, Indonesia: Sukamade beach (Meru Betiri Wildlife Park) in Java, Nusa Barung Island and Blambangan Wildlife Reserve; Thailand: ko karam beaches and Islands Taruto Marine National park and Malaysia: Marine Turtle National Park near Sandacan.

The important Green Turtle hatcheries of the world which handle eggs are at isla Los Roques, El Salvadore; Sukamade beach and Pangumbhan in Indonesia; Malaysia (Chendor in Pahang state, Dalam Ru and pulau Perhentain in Kelantan State); Hawksbay in Pakistan; Lara in Cyprus; Ogaswara Islands in Japan; Maruta bay and Colola in Mexico. Eggs are locally collected, transplanted to the hatcheries and then hatchlings are released at suitable places at definite intervals. The turtle has been listed in Appendix I of the Convention on International Trade in Endangered species of Wild Fauna and Flora (Cities). According to Appendix I listing, any international trade of the species mainly for commercial purpose is strictly prohibited by the law of the particular country in which the said species is found. The turtle populations of France, Italy, Japan and Surinam are not covered by the provisions of this listing.

Legislation should be enforced more strictly all over the world and the states with reservations must be convinced to withdraw them and allow their turtle population to be covered by Appendix I. As the Green Sea Turtle is highly migratory and has got a world wide range, there should be international co-ordination in establishing suitable conservation programmes for the species. The involved nesting beaches, feeding grounds, interesting habitats, migratory routes and hibernating spots must be protected strictly all over the world. All types of trawler operations should be banned within a reasonable distance of the turtle islands and coastal beaches. Restricted

fishing zones should be established in areas of high tutle concentrations, particularly off major nesting beaches and top priority should be given to the improvement of the fisheries gear in order to prevent incidental catch of these turtles. As far as possible, turtle' eggs should be left to hatch in natural conditions. People should be educated all over the world in conservation methods to evoke public awareness in order to protect these turtles. It has been established that the sex ratio in marine turtles in controlled by a seminatural rearing of these turtles causes fluctuations in the temperature naturally required for incubation and as such disturbs the natural sex ratio of the newly hatched individuals.

Captive breeding : Various attempts for rearing these turtles in captivity have already been made all over the world, but large-scale closed-cycle captive breeding has not yet been found beneficial commercially anywhere. Captive breeding has been tried in Australia, Cayman Island, Indonesia, Malaysia, Mexico, Philippines, Reunion and Seychelles. The farming of sea turtles has been discussed most elaborately at the 1979 conference of the conservation of sea turtles, Washington D.C. The most important conclusions drawn are, that before attempting such a programme detailed studies on the biology and the implementation of economic factors pertaining to all the population of this species are required.

Genus 3. ***Eretmochelys*** Fitzinger 1843

1843. *Eretmochelys*, Fitzimgen, *Syst. Rept.* 30 (type *Eretmochelys imbricata*)

1890. *Chelone* (in part), Boulenger, *Fauna Brit. Ind.* : 48

1931. *Eretmochelys, Fauna Brit. Ind.* 1 : 67.

Carpace almost elliptical, with 4 costal shields on each side and is covered by horny imbricate shields; two pairs of pre-frontal scales are present; nuchal not in contact with the first costal on each side; snout elongate and narrow; premixillae deeply excavated and not toothed terminally; alveolar surface of upper jaw with a single sharp-crested ridge; head is very narrow, with hooked jaws; 2 claws are present on each flipper; carapace is brown with deep brown markings, neck is light orange.

HAWKSBILL SEA TURTLE
OR
TORTOISE SHELL TURTLE

3. ***Eretmochelys imbricata*** (Linnaeus 1757)
(Figs. 47, 51, 56, 63 & 64)

1766. *Testudo imbricata* Linnaeus, *Sys. Nat.* Ed. 12, Vol. 1 : 350.

1834. *Chelonia pseudo-midas*, Lesson in Belang. *Vou. Ind. or Zool.* 299 (type loc. Atlantic ocean).

1835. *Caretta beisa*, Lesson, N. Wirbelth. *Abyss. Amph.* 4, pl. 2 (type loc. Red Sea).

1857. *Eretmochelys squamata*, Agassiz, *Contr. Nat. Hist.* U.S. 1 : 382.

1858. *Caretta squamosa*, Girard, U.S. Explore, Exp. Herp. 442, pl. 30 (type loc. Indian Ocean).

1858. *Caretta rostrata,* Girard, *U.S. Explor. Exp. Herp.* 446, pl. 30.

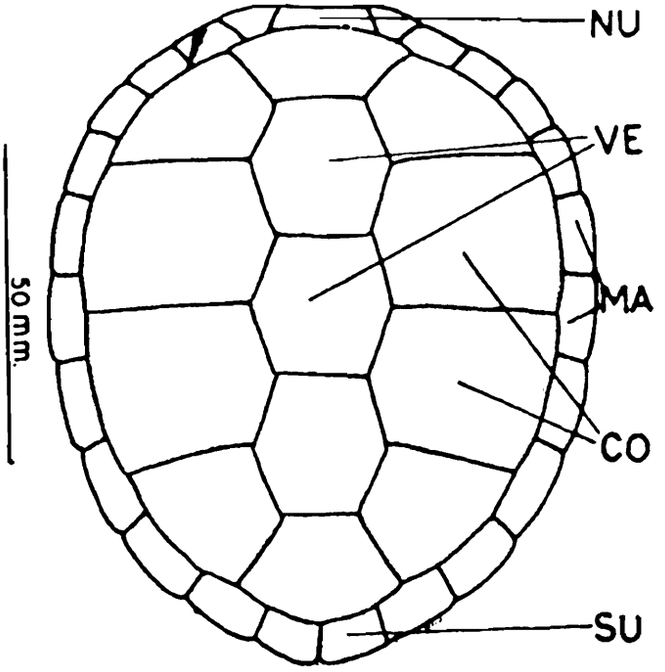
1873. *Onychochelys kraussi,* Gray, *Proc, Zool, Soc.* 398, figs. (type loc. Coast of French Guinea; Brit. Mus.).

The Hawksbill or Tortoise Shell Turtle is one of the smallest but the most colourful species of the marine turtles. Beautiful yellow mottling on the rich brown background distinguishes this turtle from other sea turtle species. A large fully grown adult may develop a shell generally about a metre in length, but most individuals would be only about 60 to 65 cm. in length. The fully grown adult Hawksbill generally attains a weight between 60-120 kg; the largest record so far is 140 kg. Its head is very narrow, with distinct scales over it, and the snout tapers to a point. Its powerful ridged jaws, which look like a hawks bill, allow it to break open molluscs, crabs and other hard animals and to pull them out from the crevices of rocks and coral reefs. Premaxilla is deeply excavated and not toothed terminally. Alveolar surface of upper jaws is with a single sharp-crested ridge. Jaws are strongly hooked. Carapace (Fig. 63) is narrow and strongly serrated behind; in the juvenile it is covered with horny plates, with is cordate and it elongates with the age of the turtle. The scutes on its shell are thicker and strongly overlapping in the young but with increasing of age the edges come to lie side by side. Dorsal scutes are horny, strongly imbricated; in very old individuals they are juxtaposed. Costal scutes are 4 on each side, first costal on each side, first costal on each side is not in contact with the nuchal scute; neural or central scutes are 5; marginal shields are 25 (including one narrow precentral and a pair or postcentral or supracaudal scutes). The plastorn (Fig. 64) consists of paired gular, humeral, pectoral, abdominal, femoral and anal shields, a single intergular and a series of inframarginal shields, head is covered with symmertical shields and with two pairs of prefrontal shields. The flippers are long and each one is provided with two claws. Tail is quite short in comparison to the body. Juveniles are brown above, blackish below. Carapace of the adult is amber coloured or greenish with violet markings or dark brown to black with yellow mottlings or blotches and in all cases with radiating brown and black streaks on the scutes. The plastron is yellow, orange or reddish brown in colour. Skin of neck is yellow or creamish. Shields of head and limbs are dark brown with yellow borders.

Distribution: Hawksbill turtle is a crcumtropical species, nesting mainly on beaches of tropical and subtropical zones of the Pacific, Atlantic and Indian oceans. The species occurs in the Mediterranean Sea also but does not breed there. The species is widespread in tropical waters but its nesting is sporadic and takes place during the night.

The Hawksbill is generally distributed in India and Indo-Chinese waters. In India these turtles are available and make nests on various islands in the Gulfs of Kutch, Gulf of Manner and in the vicinity of Lackshadweep, Andaman and Nicobar Islands.

Habits and habitat : The Hawksbill Turtle frequents shallow coastal waters with rocky coastal embnkments and coral reefs with shallow vegetated bottoms as well as



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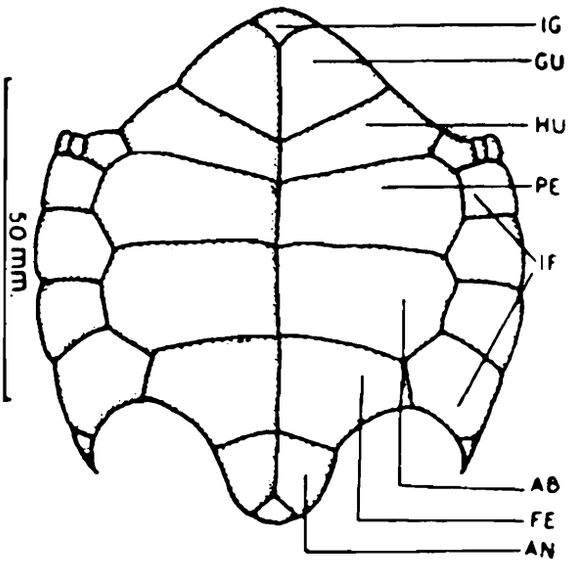

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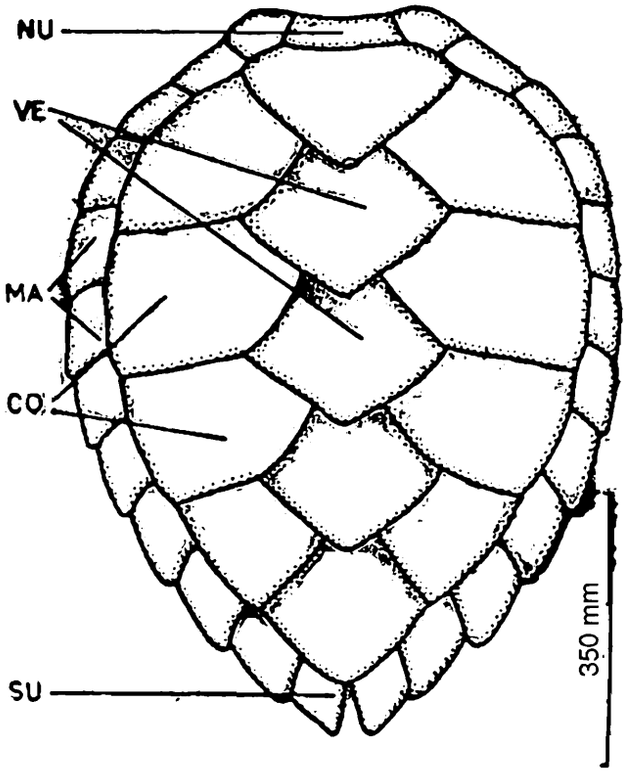

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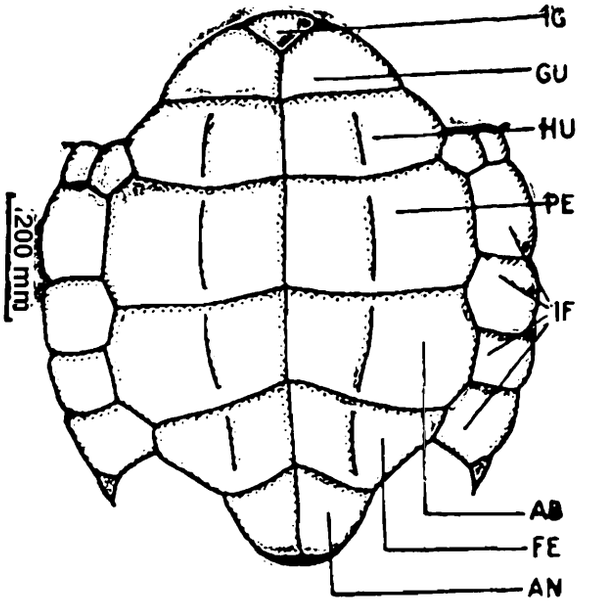

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Figs. 61 & 62. *Chelonia mydas* (Linnaeus). 61. Carapace; 62. Plastron.
Figs. 63 & 64. *Eretmochelys imbricata* (Linnaeus). 63. Carapace; 64. Plastron.

bays and lagoons with muddy bottoms lacking widespread submerged vegetation. Male turtles hardly emerge from the water and are seen propelling with their front filppers. The females only emerge from water during the night and come to the beaches for nesting. It is mainly a non-migratory species and covers short distances only in search of food. Records of its long distance migration are scanty. The hind feet are mainly used for steering and for excavation of the nest. The breeding season extends from end of August to end of February with peaks in October to January and is correlated with onset of the northwest monsoon. Age of the sexual maturity is unknown. Nesting takes place generally by night and the female turtle walks about extensively on the sandy bank before selecting a site for the nest. Nesting is aggregated at a few localities and only one or two nests are made there on any fixed night. In this process the Hawksbill Turtle differs markedly from other sea turtles. The nesting process is like that of the Green Sea Turtle. The cavity of the nest pit is like a round bottome flask and its cavity reaches a deapth of 45-50 cm. The mother turtle lays 96-182 eggs per elutch at a depth of 12-20 cm. in the nest pit during the day. The size of the egg clutch varies in different populations and is strongly correlated with mean carapace length. As such the exploitation of the largest laying female is most deleterious to the population. Eggs are round with a diameter of 4 cm. Generally 2-4 clutches are laid in one season, with re-nesting interval of around 15-19 days. Re- migration takes place after 2-4 year's gap but three years remigration is predominant. Incubation period ranges from 58-64 days. Hatchlings at the time of emergence from egg-shell are 4.00-4.2 cm. long. Annual hatchling productivity per nesting female varies between 77 and 189. Hatchlings emerge at night so are subjected to the predation by nocturnal scavengers like crabs. The strongest predator is the Ghost crab, *Ocypode ceratopthalmus*, which is generally found in abundance in the habitats of these emerging hatchlings. Dogs, pigs and lizards are among the known egg predators. Hawksbill hatchlings those likein other sea turtles, after enteering the sea, pass several months drifting along with the *Sargassum* weed mats. In experiments captive hatchlings preferred *Sargassum* grass to all other food offered during the first several weeks. As the turtle hatchlings grown in size their food choice also shifts towards various sea animals in addition to sea weeds. The fully grown adults become entirely omnivorous and a tremendous increase in their appetite has been noticed. Almost any marine animal (which can be captured and overpowered) and plant material is consumed. The food of this turtle thus comprises sponges, ascideans, echinoderms, coelenterates, ectoprocts, broyozoans, gastropod and bivalve molluscs, barnacles, crustaceans, soft corals and fishes. The vegetarian diet includes *Sargassum* and other sea grasses, fruits of mangrove plants and algal material.

Status : The Hawksbill has become extremely endangered and its population has widely depleted in many areas of its range, where it is killed in large numbers for the horny shields or keratin layer of its shell. This layer is much thickened and exhibits a remarkably beautiful yellow-brown translucence, when removed from the shell by heating. Keratin layer thus obtain is used for adornment and for making fashionable toilet articles and furniture. The cost of tortoise shell ranges between Rs. 1100–2000 per kg. in the international market. Such a large profit

tempts and instigates the turtle poachers to search even the most remote areas. During the last 15 years the international trade in tortoise shell has increased enormously and Indonesia alone exported about 320,000 kg. of unfinished raw shell in the year 1978 alone. The latest estimates indicate that at least 50,000 Hawksbill turtles are killed in Indonesia annually for this purpose. The main countries which are involved in the export of these turtles and their products are Indonesia, Philippines, Thailand, India, Fiji, Malaysia and Singapore. The major importers are countries like Japan, Taiwan, Hongkong, Italy and West Germany. The increasing tourist trade has also added devasting effects on the various populations of this sea turtle. The hatchlings and very young specimens are used as curios and there is a heavy demand for the polished shells for decorating purpose. The countries involved in tourist trade are Philippines, Indonesia, Thailand, the Maldives, the Seychelles, Madagascar, Caribean countries, Hawaii, Sri Lanka, India, Malaysia and Singapore. In some places like Indonesia, Caribbean, Papua New Guinea, these turtles and their eggs are frequently consumed. The flesh of this turtle sometimes becomes poisnous, since many invertebrates like sponges, consumed by it, are strongly toxic. Thus, sometimes its flesh, if consumed, causes sickness and even death in human beings.

Conservation : It is generally protected by legislation in various countries like Ascension Island, Australia, Indian Ocean Territory, Costa Rica, Cuba, Fiji, French, Guiana, India, Israel, Mexico, Puerto Rico, Sabah, Sarawak, Seychelles, South Africa, Sri Lanka, Surinam, Taheti, Thailand, Tonga, U.S. Pacific Trust Territory, Venezuela and many Caribbean countries.

During the last few years many hatcheries have been established in Malaysia to incubate Hawksbill eggs. The most important Hawksbill nesting beaches are on the Arnavon Islands (in Soloman group of Islands) which are strictly protected by law. The species is listed on Appendix I of CITES. France and Japan have kept their Hawksbill populations aside and these are not governed by the convention laid down by the CITES. For the survival and recovery of the existing populations of this turtle the only effective way will be to put a total ban on the international trading of this species in any form.

Captive breeding : Has not been attempted anywhere in the world so far.

Genus 4. ***Lepidochelys*** Fitzinger 1843

1843. *Lepidochelys*, Fitzinger, *Syst. Rept.* 30. (type *Chelonia olivacea*)

1880. *Calpochelys*, Garman, *Bull. Mus. Comp. Zool.* Harvard. **6** : 123 (type *Colpochelys kempi*).

Carapace almost round, with 5-9 (generally 6 or 7) costal shields on each side; carapace shields are smooth; plastron with 4 pairs of inframarginal scales on the bridge, each inframarginal is provided with pores on the hinder margin; maxillae are not in contact, separated by vomer; head is moderately small; single claw is present on each flipper. Dorsal body colouration is grey to olive-green (generally carapace is grey and plastron yellow).

OLIVE RIDLEY TURTLE
4. *Lepidochelys olivacea* (Eschscholtz 1829)
(Figs. 46, 50, 65 & 66)

1829. *Chelonia olivacea.* Eschscholtz, *Zool. Atlas* 1 : 3 (type loc. China Sea, Manila Bay and Sumatra)

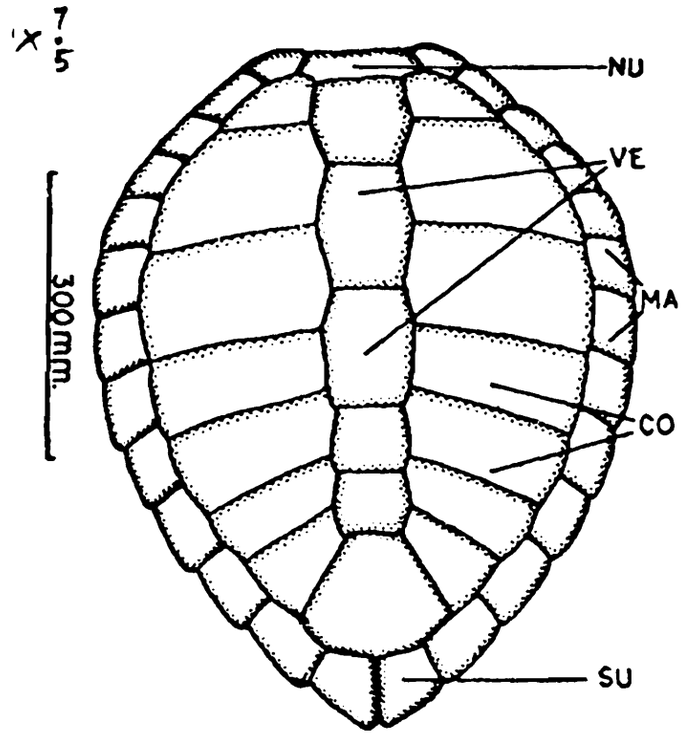
1931. *Caretta caretta olivacea,* Smith, *Fauna Brit. Ind.* 1 : 71.

The Olive Ridley is a small, broad and flattered marine turtle, whose carapace length varies between 56.5 and 75 cm. A fully grown female at the time of breeding ranges from 40 to 55 kg. in weight. Its head is large and triangular in shape and individual bones do not become completely fused until late in life. Its maxillae are separated by the vomer. The orbits are distinctly large. The Carapace (Fig. 65) in adult is arched and devoid of keels, margin is slightly serrated on the posterior aspect. Shields of the carapace are juxtaposed and exhibit variations, in different populations. The costal scutes are 5-9 (generally 6 or 7) on each side; neural or central scutes are 8-9; marginal shields are 27-29 (including 1 percentral or nuchal and a pair of postcentral or supracaudal scutes), and the mid marginals are much wider. The plastron (Fig. 66) consists of paired gular, humeral, pectoral, abdominal, femoral and anal shields; intergular is variable, may be single, double or even absent; 4 pairs of inframarginals are on the bridge, each inframarginal is provided with pores on the hinder margin. Head is covered with symmetrical shields; two pairs of prefrontals are present. Three dorsal keels are present in small young turtles which become inconspicuous in adults. Single claw is present on each flipper. Tail is quite short in comparison to the body. Dorsal colouration is grey to olive-grey or olive-green, carapace is generally olive-grey. The top of the head is grey-brown, the shields yellow-white, the plastron creamy-yellow and the edges of the flippers light yellow-brown.

Distribution : Olive Ridley Turtle is a circumglobal species and is widely distributed in the tropical waters of the Pacific, Indian and Atlantic Oceans. Its nesting takes place mainly on mainland beaches all over the world; there is little nesting on the islands of the Indian Ocean and southeast Asia.

Major nesting sites of Olive Ridley in India and around are Gorai, Kihim, Manori and Versova in Maharashtra; south of Madras and Point Calimore in Tamil Nadu; Gahirmatha Beach in Orissa, middle Andaman and Rutland in Andaman Islands, and Nicobar Islands. The minor nesting takes place on the coasts of Goa. Kerala, Andhra Pradesh, Gulf of Kutch, Gulf of Mannar and Lakshadweep Islands. Very large scale nesting in India is restricted to Orissa coast where at least 300,000 female Olive Ridleys nest every year on a 35 km. beach at Gahirmatha (within Bhitar Kanika Wildlife Sanctuary) and a 3-4 km. mass nesting site about 100 km. south of Gahirmatha beach between Nadiakhia muhana and Akasia muhana.

Habits and habitat : The Olive Ridley Turtle is capable of foraging at great depth (up to 150 metres or more) in tropical neritic waters and undertake long journeys in search of suitable feeding grounds. They swim over considerable distances offshore and float calmly over deep sea waters, waiting for certain crustaceans which emerge



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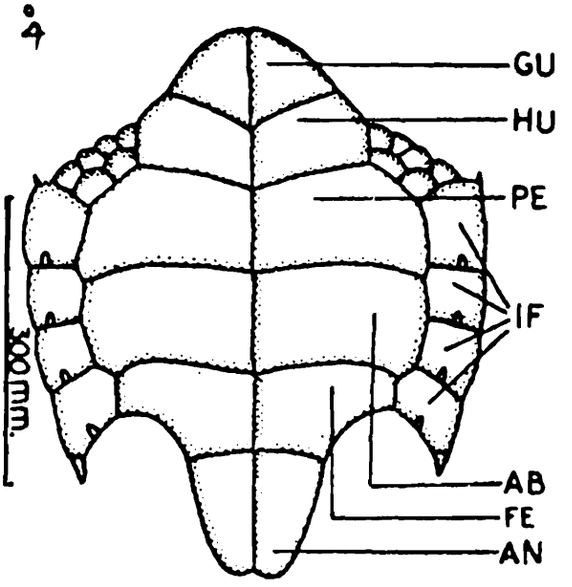

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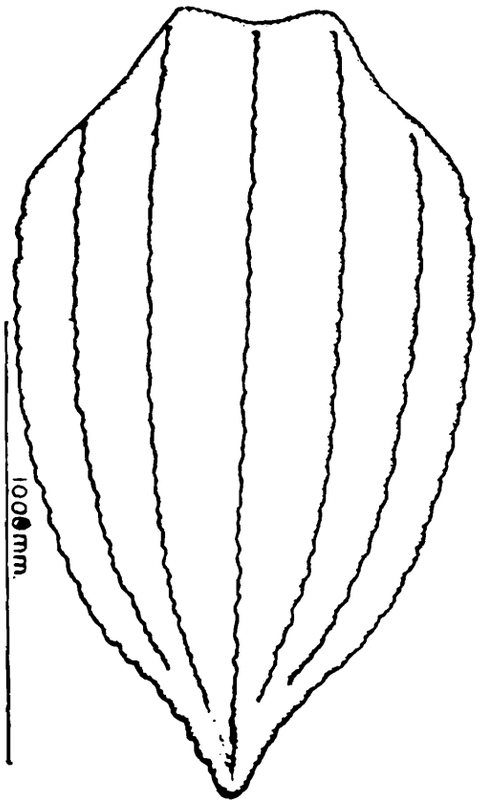

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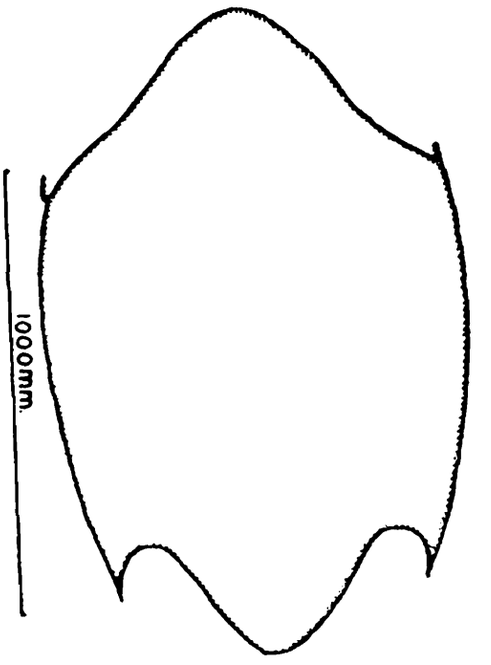

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Figs. 65 & 66. *Lepidochelys olivacea* (Eschscholtz) 65. Carapace; 66. Plastron.

Figs. 67 & 68. *Dermochelys coriacea* (Linnaeus). 67. Carapace; 68. Plastron;

to the surface of water only during the night. The Ridleys become sexually mature at the age of 8-10 years. In India (Orissa) small numbers of females emerge almost throughout the year but the large synchronized aggregations (arribada) involving 100,000 females, occures in February-March. In Costa Rica major arribada occur during September-October and involve up to 150,000 females. The general breeding season all over the world is between September-March.

Nesting takes place mainly at night and the interval between arribadas during the peak season ranges from 14-48 days at Costa Rica. The construction of the nest is usually completed within an hour and the process is exactly like that of the Green Sea Turtle or other sea turtles. Egg-laying continues for 15-20 minutes in the relatively shallow nest cavity. Nest is refilled and covered after the egg-laying is over. Female roughs up the surface of the nesting site by compacting the soil by thumping with the shell. The clutch size ranges between 74-126 at costa Rica, to 37-166 at Surinam and 90-140 at India and Sri Lanka. Eggs are round with a mean diameter of 37.5-40.5 mm. The incubation takes 49-62 days. Generally females nest two to three times during a season, at intervals depending on arribadas. Remigration of the females to the nests takes after one or two years. hatch rate of eggs and survival of hatchlings is extremely low on account of the predators like Ghost crabs, files, fungi, bacteria, hawks, vultures, caracaras, opposums, raccoons, coyotes, sharks, pumas, jaguars and human beings. Its food consists of crustaceans like crabs and shrimps, molluscs, jelly fish, tunicates, all small invertebrates, small fish and their eggs, larger planktons and marine algne.

Status : The Olive Ridley Turtle has become endangered on account of its commercial exploitation by man for flesh, skin, leather and eggs. The skin of the neck, shoulders and limbs of this turtle is utilised for the hide trade and the maximum consumption of this turtle skin takes place in Japan and various European countries (mainly Italy). Estimates show that various companies in Mexico, Equador and Pakistan (Baluchistan), trading in the turtle leather and flipper skin for luxury goods have slaughtered more than 464,000 fully grown adults since 1977. After a resolution was passed in the New Delhi CITES convention, now the commercial exploitation of the Olive Ridleys is absolutely prohibited since July 1981. Inspite of the ban, human predation on the species for egg and flesh still exists on a large scale in the various nesting sites in India, Sri Lanka, Mexico and Costa Rica. About 100,000 eggs and 500 adults from Gahirmatha (Orissa) along were sold in the Calcutta market for human consumption in the yeár 1982. The predation on eggs and poaching for adult turtles is in the extreme in Mexico and Costa Rica. The major threat is through heavy incidental catch by shrimp trawlers. The most drastic of such shrimp fishery operations have taken place in the Live Ridley populations of Surinam, French Guiana, Venezuala, India (West Bengal), Orissa and Andhra Pradesh, sougheast Africa and Mexico.

Conservation : This turtle is generally protected by law throughout its range but the enforcement is not rigid anywhere. In Costa Rica, Mexico, Central America and India predation on eggs and poaching on adults is increasing each season and eggs in very large number are removed even in the presence of guards. According to the

latest legislation a strict ban has been imposed on all the trading of these turtles and the industrialized fisheries protection programmes of the nest beaches and the incubation of oviducal eggs have already been started. Effective conservation programmes for these turtles have already been implemented in Guatemala, Honduras, Nicaragua, Costa Rica, Panama, Equador, Surinam, Angola, Mozambique, Pakistan (Hawkes Bay and Sandspit beaches), India, Sri Lanka and malaysia. The species has been listed on Appendix I of the CITES. Japan is the only country which has entered a reservation on Appendix I listing of Olive Ridley Turtle. Still there is time when serious thought can be given for the protection of this turtle and laws for the protection should be adequately and most rigidly enforced. All the major nesting beaches of Olive Ridley Turtles should be declared as National reserves and there should be a total ban on leather trade and Japan must be asked to withdraw its reservation on Appendix I of CITES listing and should give up the temptation of earning profit by importing Olive ridley leather and other products. There should be an international coordination in the formulation of conservation and management programmes and detailed investigations on the biology of this species should be carried out. Restricted fishing zones, National parks Reserves, protected beaches and suitable hatching grounds should be established. Detailed study on the biology of hatchlings immediately after hatching is needed in all the possible details. Top-most priority should be given to the development of fishing equipment for preventing incidental catch of these turtles in trawn nets.

In India, the Central Marine Fisheries Research Institute (CMFRI) has proposed a crash programme on the conservation and effective management of sea turtles including the Olive Ridleys. The investigations will include : 1. Surveying and demarcating nesting grounds of marine turtles along the Indian Coast and the Bay Islands; 2. Monitoring incidental catch of turtles in fishing operations and finding ways of means of minimising the same; 3. Developing hatchery and hatching release programme; 4. Carrying out tagging of turtles to understand their population structure, migratory habits, growth, longevity and mortality rates; 5. Investigating biological aspects and behaviour of turtles and 6. Strengthening the Marine Living Resources Data Centre (NMLRDC) for acquisition and dissemination of data on marine turtles from our Exclusive Economic Zone (EEZ).

Captive breeding : Three hatchlings from a natural nest are reported to have been maintained in captivity at Madras Snake Park Trust for two years. No other information on captive breeding is available.

Family II. DERMOCHELYIDAE Siebenrock 1909

1090. Dermochelyidae Siebenrock, *Zool. Jahrb. Jene*, Suppl. 10 : 551.

The family comprises a single species of largest marine turtle whose dorsal bony shell is composed of numerous small polygonal plates of different size which do not articulate with the vertebral column and ribs. The largest of these plates compose seven absolutely regular longitudinal ridges, separated from one another by groves. These ridges converge posteriorly and correspond to the dorsal keels of the living turtle. Posteriorly the bony shell forms a pointed supracaudal portion, and laterally

it terminates into an irregular margin just external to the outermost, dorsal keel. The ventral portion of the shell is devoid of such plates but is formed by five longitudinal incomplete rows of minute bony structures which are deeply embedded in the body tissues and correspond in position with the five ventral keels of the young. The complete body of the turtle is covered with galvanised rubber-like skin. Nuchal scute is represented by a flat, butterfly-shaped bony plate which rests upon the last cervical vertebra. Plastron comprises an annulus of 8 delicate bones namely the epiplastron, hyplaston and xiphiplastra. The entoplstron is not present in this family. Roofing of the temporal region is complete. The neck is short and slightly restractile. The limbs are paddle-shapped, clawless and feet are scaleless. The digits of the forelimb are much elongated and the phalanges are devoid of condyles. In the hatchlings vestiges of one or two claws may be present or absent. Nothing is known about the ancestory of this unique family with a single but quite distinct species of marine turtle.

Genus 5. ***Dermochelys*** Blainville 1816

1816. *Dermochelys* Blainville, *Bull. Soc. Philom.* 119 (type *Testudo coriacea* Vendelli 1761)

1820. *Sphargis,* Merrem, *Syst. Amphib.* 19

1822. *Coriudo* Fleming, Phil Zool. 2 : 271

1828. *Seytina,* Wagler, *Isis.* 861 (*subst. name for Spharigs*)

1832. *Chelyra,* Rafinesque, *Atlantic Journ.* 1 : 64 (type species *Testudo coriacea*)

LEATHERBACK SEA TURTLE
5. ***Dermochelys coriacea*** (Vandelli 1761)
(Figs. 52, 57, 67-71)

1761. *Testudo coriacea* Vandelli, Epistola de Holoturio et Testudine coriacea ad Celeberrimum Carolum Linnaeaum, Padua : 2 (Maris Tyrrheni oram in agro Laurentiano).

1766. *Testudo coriacea* Linnaeus, *Syst. Nat.* Ed. 12 : 350.

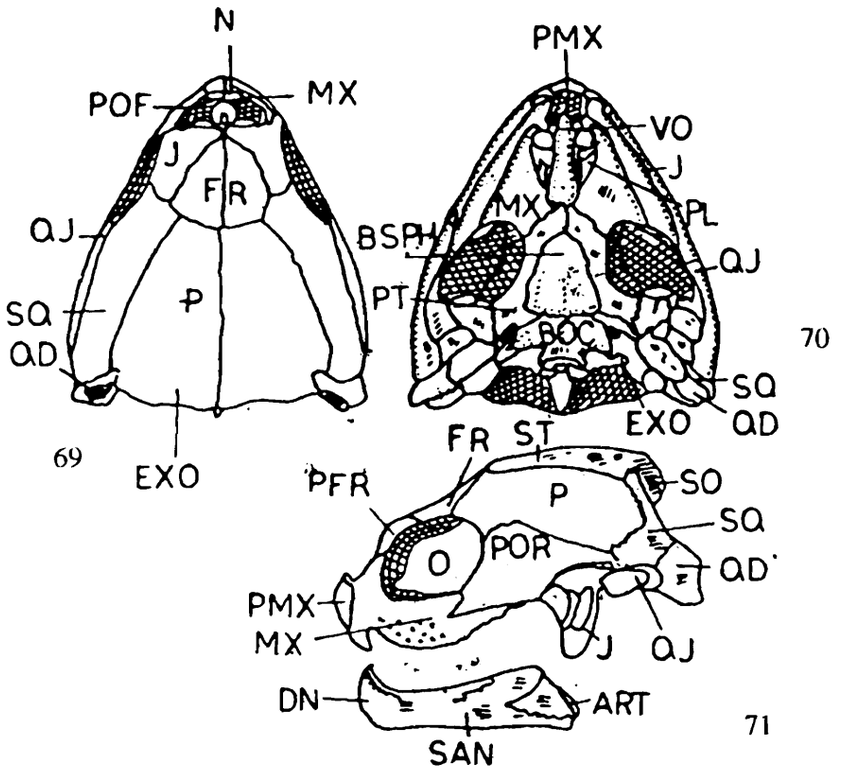
1829. *Sphargis tuberculata,* Gravenhorst, *Delic. Mus. Vratisl.* 9.

1889. *Sphargis angusta,* Philippi, *An. Univ. Chile* 94 : 730, 1 pl.

1931. *Dermochelys coriacea*, Smith, *Fauna Brit. Ind.* 1 : 59.

The Leatherback Sea Turtle or Luth is the largest and heaviest of all living turtles and tortoises of the world. Its body shape is somewhat triangular in shape resembling the ancient musical instrument 'lute', as such its name as Luth comes after lute only. Its carapace-length varies between 140-200 cm. Its average weight is about 400 kg. and the maximum recorded is 725 kg.

The hatchlings and very young individuals have scales and their complete body and limbs are covered with small, irregular, polygonal shields which are largest upon the carapace and plastron. The top and sides of head in the yound have symmetrical plates. The scaly and shielded pattern disappears as growth takes place and in the fully grown up adult they are replaced by smooth skin. The flesh and skin of the



Figs. 69–71 *Dermochelys coriacea* (Linnaeus). 69. Skull : Dorsal view; 70. Skull : Ventral view; 71. Skull : Lateral view.

Leatherback are extremely oily and the species is devoid of all corified epidermal structures. In the adult, the carapace (Fig. 67) is smooth-skinned and rubber-like and is made up of 7 strong, nodular longitudinal ridges which provide it considerable rigidity. There is no sharp angle between the carapce and the plastron (Fig. 68). In young 7 dorsal and 5 ventral keels are available. The 5 ventral keels of the young become obliterated in the adult, as such the ventral plastral surface becomes absolutely smooth, but the 7 dorsal keels of the yound are replaced by 7 strong ridges in the adult. The jaws of Leatherback are devoid of flattened horny plates or alveolar surface but their margins are with sharp edges. The lower jaw bears a median hook and the upper jaw a pair of strong cusps flanked by 3 deep notches. Its head is large and the neck is massive. The limbs are paddle-shapped and clawless. Its front flippers are triangular, extremely long, enlarged and powerful, their span in a 2 metre long turtle is roughly up to 2.8 metres when fully extended. The hind flippers are broad and are connected to the tail by folds of thick skin. Tail is quite short in comparision to the body. The carapace is slaty black with white spots; ventral colouration is variable and is generally a mixture of pink, white and black. Sometimes the spots have a pink or bluish tinge. In mature females, the crown of the head has a pink spot. The tail is black.

Distribution : The Leatherback Turtle is a circumglobal species and its nesting takes place on the beaches of tropical seas of the Atlantic, Pacific and Indian Oceans.

In India its nesting has been reported from Quilon on the Kerala coast, Goa and certain parts of the east coast. Moderate aggregations of nesting Leatherbacks occur every year on certain isolated beaches of the Andaman, Nicobar and Lakshdweep Islands. The populations of emerging Leatherbacks are said to be highest on Great Nicobar and Little Andaman Islands.

Habits and habitat : The Leatherback Turtle is virtually a pelagic species depending on land simply for nesting. The large, bulky, thick-skinned, oil-saturated body with a low surface helps the creature in maintaining sufficient temperature while foraging in cool water of certain temperate zones. It is a powerful swimmer with a strong instinct for migration and prefers to stay in the open seas. The longitudinal ridges and grooves on the carapace and stremlined, boat-shapaed body also provides extraordinary capacity to this turtle in maintaining hith-speed swimming. This is a most secretive animal and rarely can be seen away from its nesting areas. The nesting season varies from place to place, it is between March and July on all the nesting beaches on North Atlantic and ranges from October to February in the countries of the East Pacific. It breeds three or four times a year but the peak period is during May and June. The nesting takes place at night and the nesting female ascends on the sandy beaches after emerging from the water. Its massige egg-loaded body is heaved quickly, on the sandy beach with the help of powerful and simultaneous movements of the front flippers. The general nesting process is like that of other marine turtles. The female turtle scoopes a shallow nest-pit 60-100 cm. deep, by making vigorous movements by using all the four limbs and tail. It enlarges the nest cavity by excavating the nest soil and throwing it back by making powerful, steady alternating thrusts of the hind limbs. The female remains most undisturbed at the time of egg deposition. After egg laying the nest cavity is refilled and surrounding area is compacted by the use of hind flippers and the body weight. The sand is disturbed all over the vast area surrounding the nesting spot by the vigorous backward strokes of the fore flippers. After hiding the nest spot the much lightened and agile female returns back to the sea. An individual may nest as nine times in a season at intervals of about 10 days. Re-migration takes place after an interval of 2 or 3 years. A normal clutch includes 80-85 eggs but the mean number of fertile eggs ranges from 66-104. Several clutches are laid during a year. Eggs are white, generally spherical with a diameter of 53 mm. The incubation period ranges from 56-70 days and suffessful hatching varies from 63-76 per cent. The hatchlings are 55-63 mm. in length. The predators of eggs and hatchlings of this turtle comprise Ghost crabs, pigs, monitor lizards, birds, small mammals and sharks. Adults are devoured by sharks. The main food of this large turtle comprises various species of jellyfish like *Cyanea capillata, Rhizostoma cuvieri, Rhizostoma pulma,* Cabbage head jellyfish *Stomolophus meleagris, Catostylus mosaicus* and ascidians. This turtle lives almost entirely on jellyfish a peculiar diet for a large animal as jellyfish contains more than 96 per cent water. When fish, molluscs, shrimps and other marine animals are found in its stomach, it is because they were first eaten by the jellyfish.

Status : The species has become endangered on account of excessive consumption of eggs and adults for food. Adults are also used for oil and as a shark-bait. Incidental catch in shrimp trawls and squid nets, and habitat disturbance are other major factors for population decline. No international trade in Leatherback parts or derivatives has been reported from anywhere. The flesh of this turtle is considered not very suitable for human consumption in major parts of its range but still the exploitation for its meat as food, for shark bait and for its oil for caulking boats is at an alarming level in the certain countries. In India and Sri Lanka the maximum exploitation of this turtle is for eggs.

Conservation : The species is generally protected by legislation in various countries like Australia, Costa Rica, Dominican Republic, French Guiana, Indonesia, Malaysia, Mexico, Mozambique, South Africa, Sri Lanka, Surinam and U.S.A. The operation of drifnets, which entrap turtles is prohibited along various nesting beaches during the nesting season. The species is listed on Appendix I of CITES and also as Endangered under the 1973 U.S. Endangered Species Act. For the survival of the species and for preventing decline in its exploitation for any purpose. All the laws for protection must be enforced with strict rigidity. The people who are engaged in the trade of this turtle for eggs and meat shold be provided with alternative jobs for their survival. In the effective areas of exploitation general public awareness for the conservation of this species must be evoked. Certain beaches where large scale nesting of this turtle takes place must be fenced off. Restricted fishing zones should be established in areas of high Leatherback concentrations.

Captive breeding : This is absolutely a free pelagic marine turtle and dislikes any unnatural habitat like a holding tank for captive breeding. Hatchlings do not survive in captivity for more than few months. Efforts for captive breeding are being made in U.S.A and Japan but nowhere it seems to be a success so far.

Family III. PLATYSTERNIDAE Gray 1870

1870. Platysternidae Gray, *Cat. Sn. Rept. Supl.* 1 : 69.

This monotypic family is based on a single genus and species. The sole member of the family, *Platysternon megacephalum* is a fresh water species living in the mountain rivers of Southeast Asia, (Burma, Thailand, Laos Cambodia, Vietnam, Hainan Island and Southern China) feeding on small invertebrates. The neck is not completely retractile within the shell owing to the very large head. The temporal region of the skull (Figs. 72-74) is completely roofed over by the expanded parietals and post frontals. Parietals not touching the squamosals. Jugal is surrounded by numerous bones, thus not participating in the formation of orbit. The carapace is depressed, keeled, covered by epidermal horny shields and its nuchal plate is devoid of costiform process. The plastron is not hinged, quite large, oblong and formed by the nine bones, which are separated from the marginals by inframarginals. Phalanges are provided with condyles, digits are prominently distinct and are with four or five claws. Tail is very long in comparision to the body.

Genus 6. ***Platysternon*** Gray 1831

1831. Platysternon, Gray, *Proc, Zool. Soc.* : 106

The main characters of this monotypic genus are : Head is very large and with a bony tip; cannot retractile with in the shell; covered above with an individed large horny shield; jaws are powerful and strongly hooked. Carapace and plastron are united by a ligament. Digits are not webbed completely, except outer one all are clawed. Tail in some individuals surpasses the length of the shell and is provided with flat, circular or square shaped scales on the dorsal aspect but base of the tail bears strong projecting tubercles. Scent (Musk) glands are present in axillary and inguinal regions.

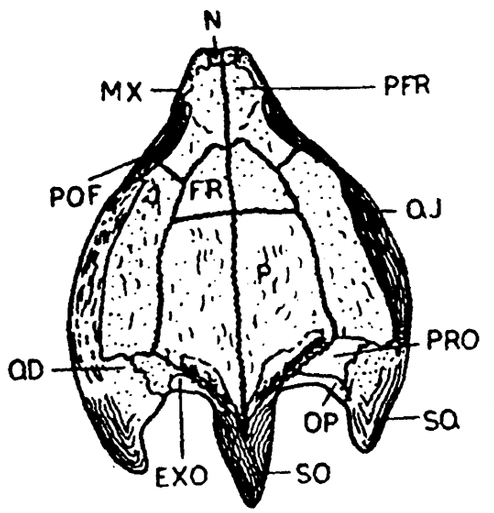
BIG HEADED TURTLE
6. ***Platysternon megacephalum*** Gray 1831
(Figs. 72-76)

1831. *Platysternon megacephalum* Gray, *Proc. zool. Soc.* London : 107.

1870. *Platysternon peguense*, Gray, *Cat. Sh. Rept.* : 70. Type-locality : Pegu, Burma. Typelocation : British Museum.

1887. *Platysternum megacephalum*, Boulenger, *Ann. Mag. Nat. Hist.* (5) xix 461, pls. xvi & xvii (Osteology).

This small turtle rarely exceeds 17 cm. in carapace length in males, when full grown up. The females are still smaller. The head is very big, nonretractile but dorsally protected by a single large horny scute. The jaws are very strong, massive and hooked; throat with round flat tubercles. The carapace (Fig. 75) is concave medially keeled and flattened antero-dorsally; with a wide nuchal indentation in the front, which gives a firm support to accomodate the massive head and short neck; its posterior margin is serrated in juveniles; nuchal shield very small, broader than long; vertebrals broader than long, as broad as or slighlty narrower than the costals in the adult much broader in the juveniles. The plastron (Fig. 76) is large, oblong, widely separated from the marginal plates by inframarginals and not hinged. The front lobe of plastron is like a square; hind lobe angularly emarginate; plastral bridge is narrow, its width is one fourth to one fifth of the length of the plastron; the longest plastral shields are the anals, the femorals, or the humerals; the gulars are the shortest shields in the plastron, but from its entire anterior margin; a small intergular shield is generally present between the gulars and the humeral shields. The plastron consists of paired gular, intergular, humeral, axillary, pectoral, abdominal, inguinal, femoral and anal shields. Limbs are weak, with large, squarish or pointed, horny scales; hinder part of thighs with conical tubercles. General dorsal colouration is olive or reddish-brown and usually with fine black lines radiating all over in adults. In juveniles the dorsal colour is similar to the adult except a black central spot in each costal shield. Ventral colouration is yellowish in young as well as the adult individual except that the young ones are orange in life and with the dark symmetrical spots along the middle of the plastron. Soft parts are reddish-brown in the young and dark brown in the adults above. In the young a yellow stripe with black marging starts from behind the eyes and extends backwards. In the young the lower side of the soft parts remain yellow or pink, with a black line along the middle of the tail.



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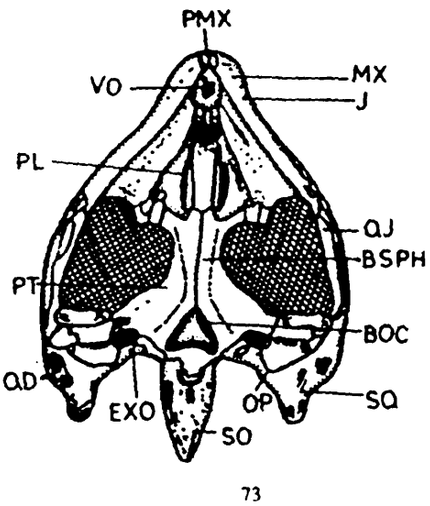

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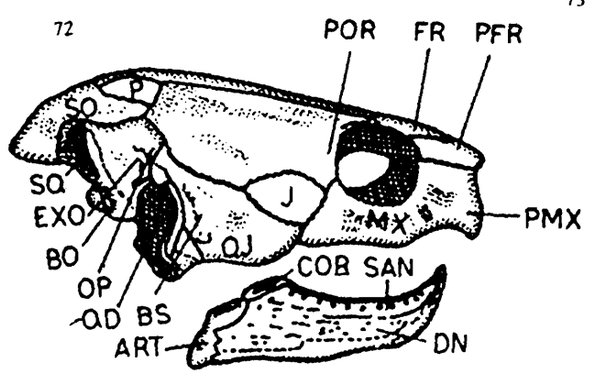

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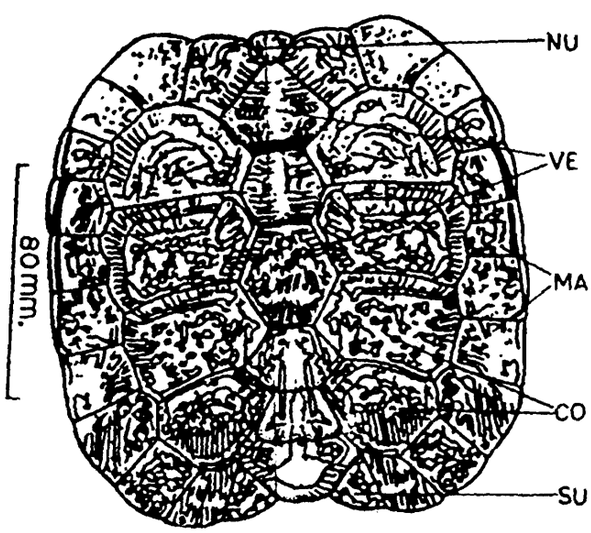

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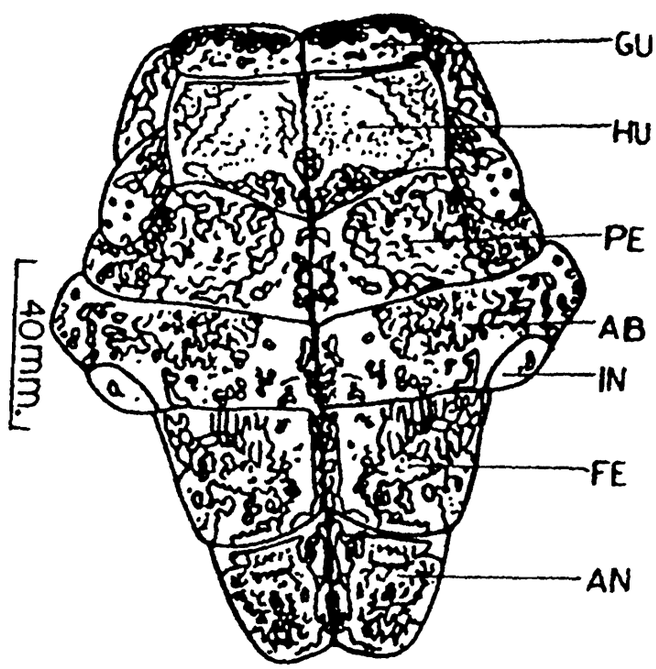

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Figs. 72 – 74. Skull of *Platysternon megacephalum* Gray. 72. Dorsal view; 73. Ventral view; 74. Lateral view.

Figs. 75 & 76. *Platysternon megacephalum* Gray. 75. Carapace; 76. Plastron.

Distribution : Three subspecies of *Platysternon megacephalum* Gray are recognised viz., *Platysternon megacephalum megacephalum* Gray, 1831 from Southern China, *Platysternon megacephalum peguensis* Gray 1870 from southern Burma, Thailand and Indo-china and *Platysternon megacephalum vogeli* Wermuth 1969 from Thailand.

Habits and habitat : The species is entirely aquatic inhabiting mountain strems and rivers in remote areas. It can climb trees, rocks and other such places easily with the help of its claws in search for food and for basking in the Sun. It feeds on small invertebrates like snails, worms and arthropods. Captive specimen devour meat, fish, worms and snails. The species is most pugnaceous and bites readily inflicting severe wounds with powerful hooked jaws. It lays two eggs in a single clutch.

Status : The species has become extremely vulnerable as its flesh is consumed on a very large scale throughout its range. The condition is said to be the worst in China and Burma where it is sold in open market for food.

Conservation : Generally protected under legislation throughout its range but the conservation means are not effective.

Family IV EMYDIDAE Gray 1825

1825. Emydidae, Gray, *Ann. Phil.* 10 (2) : 210.

This family comprises the largest number of living fresh water and terrestial Tortoises or Terrapins; whose neck is completely retractile within the shell. The shell is covered with the epidermal scutes; carapace is oval, arched or flattended; nuchal shield is devoid of properly developed costiform process. Plastron is composed of nine bones and is in contact with the marginal shields of carapce. Hinder aspect of ear chamber is not completely closed and as such stapes is exposed; temporal region is not roofed over; a bony temporal arch may be present or absent. Digits are usually webbed; toes usually elongated, median digits with three phalanges; metacarpals elongate; claws are four or five. Top of the head is covered anteriorly with smooth undivided skin, on the posterior portion of the top of head, the skin is divided into many moderate to large shields. Eggs are oval or elongate. Axillary and inguinal scent-glands are present. The family has got a world wide distribution except Australia and Papuasia and is represented by 31 genera and 142 species. This work which is exclusively on Indian Region comprises 10 genera and 20 species.

Key to the Genera

1. Vertebral shields hexagonal and short-sided anteriorly 1

A. Plastron and carapace suturally articulated. Axillary and inguinal buttreses well developed and extend almost up to vertebral shields; alveolar surface of jaws broad with one or two median ridges 2

   a. Fourth vertebral shield small as long as broad, smaller than third vertebral shield; fore limbs with 4 claws only ..... ***Batagur***

   b. Fourth vertebral shield moderate not longer than broad, not longer than third vertebral shield; fore limbs with 5 claws ..... ***Hardella***

   c. Fourth vertebral shield elongate, large, much longer than third vertebral shield; fore limbs with 5 claws ..... ***Kachuga***

B. Plastron and carapace suturally articulated. Axillary and inguinal buttresses short, do not extend even half way along the costal plates.
   a. Alveolar surface of jaws broad but without median ridge ..... ***Geoclemys***
   b. Alveolar surface of jaws broad but with a median ridge ..... ***Morenia***

2. Vertebral shields hexagonal and short-sided posteriorly
   Plastron united to carapace by a ligamentous tissue, may or may not be provided with a distinct bridge 3
   a. Carapace unicarinate, not flattened on the vertebral region, posterior margin of the carapace less serrated in adult; plastron not closing the shell completely, a short but distinct bridge is present, not provided with a distinct plastral hinge in the adult, only anterior plastral lobe is movable; digits fully webbed ..... ***Cyclemys***
   b. Carapace strongly tricarinate, much flattened on the vertebral region, posterior margin of carapace strongly serrted in adult; plastron not closing the shell completely, a short but distinct plastral bridge is present, provided with a distinct plastral hinge in the adult, only anterior lobe of the plastron is movable; digits half webbed..... ***Pyxidea***
   c. Carapace with an indistinct vertebral keel rounded and depressed on the vertebral region, plastron closing the shell completely, not provided with a plastral bridge, provided with a distinct hinge in the adult, both the anterior and posterior plastral lobes are movable; digits strongly webbed..... ***Cuora***

3. Vertebral shields hexagonal and short sided posteriorly
   Plastron united to carapace by a suture
   a. Bony temporal arch and squamosal bone not present; upper jaw hooked; skin of hinder part of head divided into moderately large shields; hind limbs club shaped; fingers one third webbed ..... ***Heosemys***
   b. Bony temporal arch and squamosal bone present; upper jaw feebly notched at the middle; skin of hinder part of head divided into very large shields; hind limbs flattened; fingers half webbed; more than half webbed; more than half webbed or fully webbed ..... ***Melanochelys***

Genus 7. *Pyxidea* Gray 1863

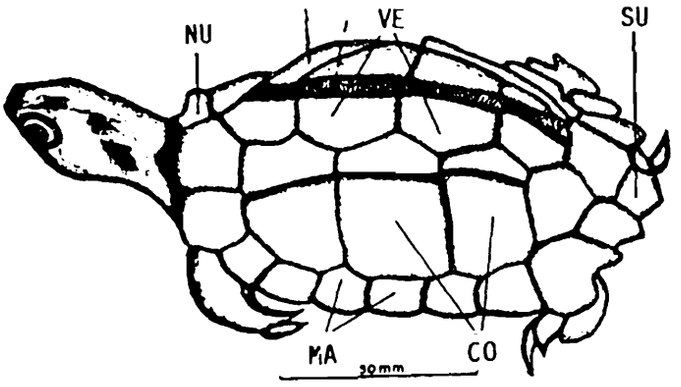
1863. *Pyxidea* Gray, *Proc. zool. Soc. Lond.* 175 (type *Pyxidea mouhoti*)

ASSAM FRESHWATER TORTOISE
7. *Pyxidea mouhoti* (Gray 1862)
(Figs. 77 & 78)

1862. *Cyclemys mouhoti* Gray, *Ann. Mag Nat. Hist.* 10(3) : 157. (type loc. Laos Mountains, Anam-Siam border; Brit. Mus.)

1931. *Cyclemys mouhoti*, Smith, *Fauna Brit. Ind.* 1 : 78.

This is a small tortoise reaching a maximum length of 17 cm. The head is moderately small, snout shorter than the orbit and truncate, skin of the posterior part of head is divided into large shields. Skull with a bony temporal arch. Alveolar surfaces of jaws narrow and upper is with a prominent median hook. The carapace



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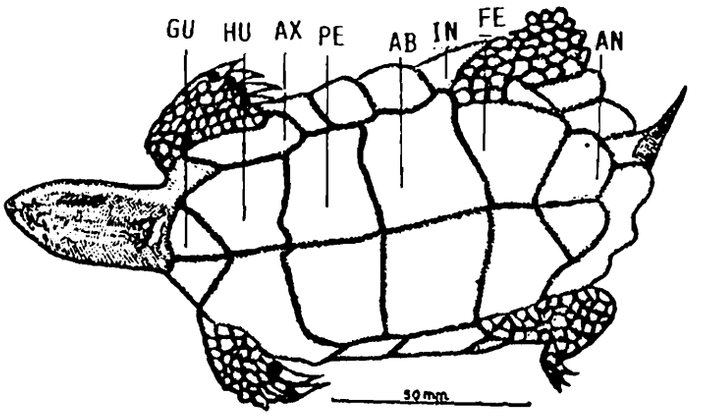

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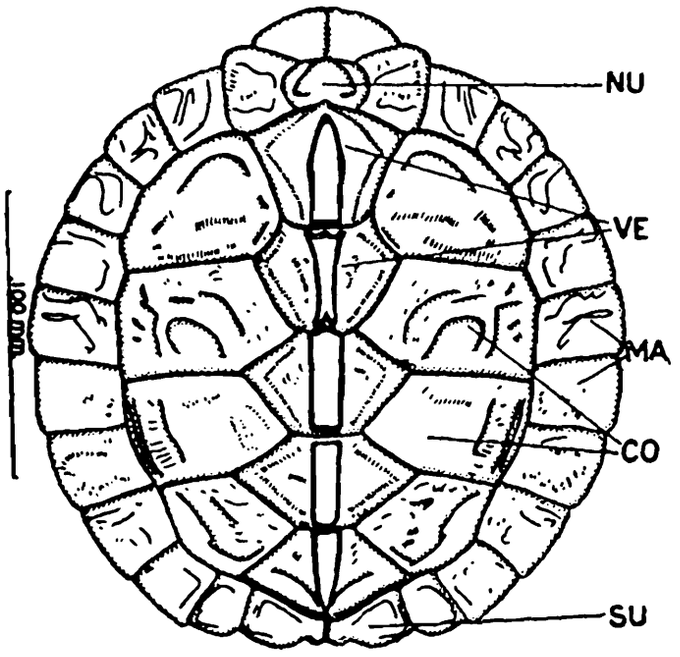

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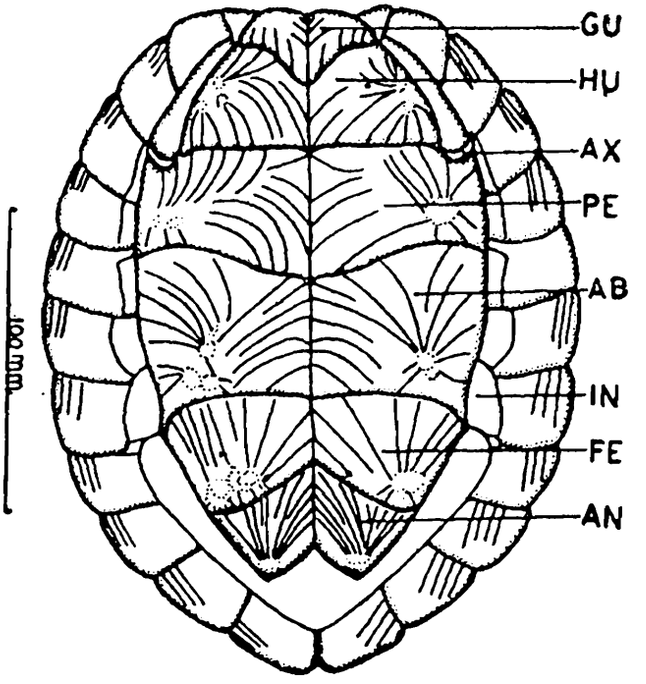

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Figs. 77–78 *Pyxidea mouhoti* (Gray). 77. Carapace; 78. Plastron.
Figs. 79–80 *Cyclemys dentata* (Gray). 79. Carapace; 80. Plastron.

(Fig. 77) is strongly tricarinate, greatly flattended on the vertebral region; anterior and posterior margins are serrated. Neural plates of the carapace hexagonal and with a narrow posterior margin. Nuchal shield is quite long and narrow; first vertebral shield is broadest on the posterior margin in the adults and is narrower; first vertebral shield is broadest on the posterior margin in the adults and is narrower than second; second, third, and ourth vertebral shields much broader than long, almost as broad as the costal shields. Plastron (Fig. 78) smaller than the opening of the shell, truncate anteriorly, notched posteriorly united to the carapace by ligamentous tissue, with a short but absolutely distinct bridge, its width one-third the length of the plastron, the hypoplastral bone contributes more to the formation of the bridge than the hyoplastral bone; with an indistinct hinge between the hyo - and hypoplastral bones; only the front plastral lobe is movable; entoplastron intersected by the humero-pectoral suture; the longest median suture is between the abdominal shields, the shortest is between the gular shields; the suture between the pectoral and the abdominal shields corresponds with the hinge between the hyo and hypoplastral bones. Axillary shield may be present or absent. Limbs are with half webbed digits, fore arm is completely covered with large, imbricate, horny shields, hind limbs club-shaped, its lower part and the sole of the foot with imbricate, pointed, horny shields. Tail is moderately long, its base and the adjacent skin of the thighs with pointed tubercles. Dorsum uniformly light brown, laterial most portion of the costal shields is dark brown. Ventrum yellowish-brown, with a dark spot on each plastral shield. Head brownish with dark vermiculations; temporal region with dark edged light spots.

Distribution : India : Assam. Elsewhere : Laos, Vietnam. Hainan

Habits and habitat : The species is docile, quite active, omnivorous, at ease in water as well as on land, and juveniles prefer to live in hill streams. It lays one to three eggs in a single clutch measuring 51-56 mm. in length and 25-27 mm. in width.

Status : Insufficiently known.

Conservation : Conservation measures have not so far been implemented adequately for the protection of this species. As a protective measure the species must be included in Appendix I of the Indian Wild Life Act.

Genus 8. *Cyclemys* Bell 1834

1834. *Cyclemys* Bell, *Proc. Zool. Soc.* 17 (type *Cyclemys orbiculata*)

GARO AND KHASI HILLS TORTOISE
8. *Cyclemys dentata* (Gray 1831)
(Figs. 79 & 80)

1831. *Emys dhor* Gray, (in part), *Syn. Rept* 1 : 20 (corrected to *dentata* in Errata).

1855. *Cyclemys dentata* (Gray) : *Cyclemys dentata* (Gray, 1855) : *Cat, Sh. Rept.* 42 pt. 19.

[Note: *i.* This species was first of all published by Gray in 1831 as *Emys dhor.*
ii. Gray himself corrected and shifted *Emys dhor* to *Emys dentata* in Errata in the same year 1831.
iii. Gray shifted this species to the genus *Cyclemys* in 1855 as such the reference 1855. (*Gray*) : *Cyclemys dentata Cat. Sh. Rept.* 42 pl. 19.]

This is a moderately large species reaching up to 24 cm. in length. The head is moderately large, snout shorter than the orbit, slightly projecting beyond the lower jaw. Skin of the posterior portion of head is divided into large shields. Skull with a bony temporal arch. Alveolar surfaces of jaws narrow, and upper jaw is feebly bicuspid and hooked. The carapace (Fig. 79) is depressed and considerably flat, almost as broad as long in the juveniles, slightly more convex and elongate in the fully grown individuals. Neural plates of the carapace hexagonal and with a narrow posterior margin. Vertebral region with a strong obtuse keel in the young but disappears in the aged individuals. The posterior margin of the carapace strongly serrated in the young but comparatively less so in the adult. The nuchal shield is not very large; first vertebral broader in the front than behind in the young but the reverse is the case in fully grown individuals, where it has wavy lateral margins; second to fourth vertebrals are as broad as long or slightly broader than long but always narrower than the costals. Plastron (Fig. 80) narrower than the opening of the shell, truncate, openly emerginate anteriorly, notched posteriorly, not completely closing the shell, united to the carapace by ligamentous tissue, with a short but absolutely distinct bridge; with an indistinct hinge between the hyo - and hypoplastral bones; only the front plastral lobe is movable; entoplastron intersected by the humero-pectoral suture; the longest median suture is between the pectoral shields, the shortest between the humeral or the gular shields and a small inguinal shield may be present. Limbs are with fully webbed digits and have transversely engalrged scales. Tail moderate, thin and pointed, longer in the young than in the adult. Colouration of this species is most variable. General dorsal colouration is dark brown or olive brown or black, in many individuals dark rays are available on carapace, juveniles are generally with a chestnut tinge all over the dorsum. Head is brownich generally with black spots. Neck is light yellow with dark longitudinal streaks.

Distribution : India : Assam : Elsewhere : Burma, Indonesia (Borneo, Java, Sumatra and other islands), Malaysia, Phillippine Islands, Thailand and Vietnam.

Habits and habitatd : The species is most active, and is omninvorous, juveniles are absolutely aquatic and prefer to live in the hill streams. Adults are entirely terrestial. It lays from two to four eggs in a single clutch, and measuring 52-57 mm. in length and 27-30 mm. in width.

Status : Insufficiently known.

Conservation : No conservation measure had so far been taken on the species. As a protective measure it has already been proposed for the inclusion of the species in Appendix I of the Indian Wildlife Act.

Genus 9. *Cuora* Gray 1855

1855. *Cuora*, Gray, *Cat. Sh. Rept.* 41 (type *Cuora amboimensis*)

1890. *Cyclemys*, Boulenger, *Fauna Brit. Ind* : 28

1931. *Cuora*, Smith, *Fauna Brit. Ind.* 1 : 84.

The main generic characters are : Carapace rounded, but somewhat depressed, vertebral shields broader in front; carapace and plastron are with a prominently distinct by - hypoplastral hinge in juvenile as well as fully grown individuals; both the

halves of the plastron are movable and provide the turtel an ability to close the shell completely; union of the carapace and plastron is ligamentous, a distinct bridge is not present; posterior border of carapace is smooth; entoplastron is intersected by the humero- pectoral suture; skull is with a bony temporal arch; alveolar surface of jaws narrow; digits strongly webbed; tail short or moderate.

Distribution : Burma (Tenasserim); Thailand, Cambodia; North and South Vietnam; Southern China, Malaysian Peninsula and Archepelago; Indonesia (easterly up to Ambonia, Sulawese) Philippines (Luzon, Polilla, Dinagat and Mindanao).

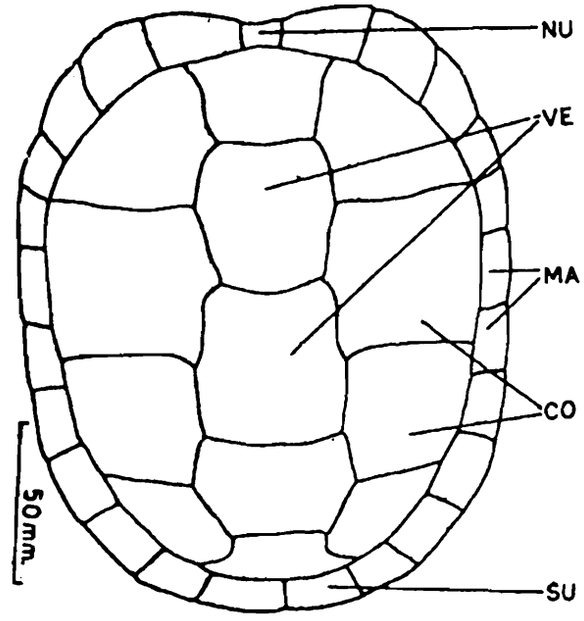
AMBOINA OR MALAYAN BOX-TURTLE
9. *Cuora amboinensis* (Daudin 1802)
(Figs. 81 & 82)

1802. *Testudo amboinensis*, Daudin, *Hist. Nat. Rept.* 2 : 309 (type loc. Island of Amboyna).

1864. *Cuora amboinensis* (Daudin) : Gunther, *Rept. Brit, Ind.* 12, pl. 4

1890. *Cyclemys amboinensis*, Boulenger, *Fauna Brit. Ind.* 31, fig. 10.

The Amboina is a small, strongly web-footed, aquatic Box Turtle reaching a length of 21 cm. The head is moderately large, upper jaw is slightly hooked, snout almost as long as the orbit and slightly project beyond the lower jaw. The skin of the posterior region of head is smooth which is divided into many large shields in few adult individuals. The skull is characterised by having a bony temporal arch, quadrato-jugal remain in contact with the jugal and post-orbital, bony chonae is almost on level with the posterior portion of the orbits, alveolar surface of jaws are narrow. The carapace



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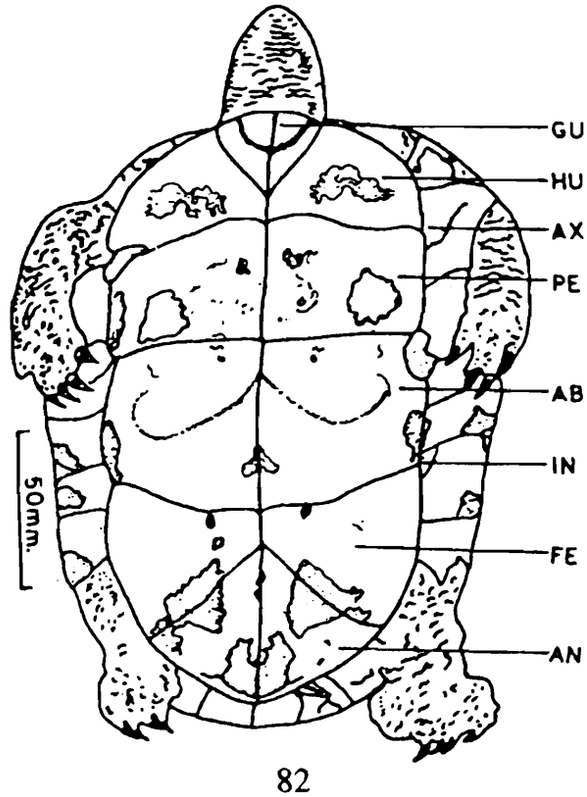

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Figs. 81&82 *Cuora amboinensis* (Daudiu). 81. Carapace; 82. Plastron.

(Fig. 81) is dome-shaped, somewhat rounded and depressed; with a distinctly prominent obtuse median vertebral keel and generally with two lateral keels, which are quite fine and distinct in the young turtles. In the adult aged Box turtles the carapace becomes more elongate and convex and the vertebral keel becomes indistinct; posterior border of the carapace is always smooth; nuchal shield is small; the first vertebral shield remains broader on the posterior side than the anterior side throughtout the life; the second and third vertebral shields are generally as long as broad but in few adult individuals their length is more than the bredth; these shields are much narrower than the costals. The plastron (Fig. 82) is as large as the carapace, somewhat rounded, and completely closes the shell by uniting with the carapace by a ligament; the bridge is not distinct; the longest median suture is between the abdominal shields and the shortest is between the humeral or the femoral; axillary and inguinal shields are either absent or if present in certain individual are small and elongate. Digits are fully webbed; limbs with transversely enlarged, subimbricate scales; the sole of foot with numerous small flat scales, in some individuals their number exceeds even 50. Tail is short. The carapace is dark olive, brown or black in colouration. The plastron is yellowish-white, generally with a dark-black spot at the outer and posterior marging of each shield; the colour at the sutures between the shields is yellow. In the young individuals the plastral dark spots becomes confluent, forming a median longitudinal patch. The head is dark brown or green above, yellow below, and wth a bright yellow band broders the top of the head on both sides and meet at the nostril; a second paler band passes through the eye and is separated from the margin of the upper jaw by a dark band; a thid band borders the lower jaw. Limbs yellowish or olivaceous.

Distribution : Burma (Tenasserim); Thailand; Cambodia; North and South Vietnam; Malaysia, Indonesia as far east as Sulawest and Amboina; Philippine Islands (Mindanao, Polillo, Luzon, Dinagat).

Habits and habitat : The Amboina is found in low-land aquatic habitats in throughout its range and is generally available in ponds, marshes and flooded agriculture fields. The main food comprises the vegetable matter. According to Malcolm Smith it is very shy and docile and consumes small quantity of vegetable matter. But according to Pritchard it becomes omnivorous and becomes a voracious feeder in captivity. Only few large eggs are laid in a single clutch, which measure 40-46 mm. in length and 30-34 mm. in width.

Status : The species is quite abundant in throughtout its range. It is a most common Box-turtle in Malaysia.

Genus 10. ***Heosemys*** Stejneger 1902.

1902. *Heosemys* Stejneger, *Proc. Biol. Soc.* Washington 15 : 238 (type *Geoemyda spinosa*).

1931. *Geoemyda*, Smith, *Fauna Brit, Ind.* 1 : 88-89.

The main generic characters are : Vertebral shields short-sided posteriorly; vertebral keel is prominent but lateral keels are feeble or missing; plastron united to carapace by a suture; bony temporal arch and squamosal bone not present; alveolar surfaces of jaws narrow, without median ridge; choanae on a level with the anterior

part of the orbit; upper jaw hooked; skin of hinder part of head divided into moderately large shields; hind limbs club shaped; fingers one third webbed.

Key to the species of ***Heosemys***

1 Carapace depressed, tricarinate, with a feebly reverted and non serrated posterior margin; anterior margin of the shell not serrated; upper jaw hooked; second vertebral shield as broad as the second costan ..... *silvatica*

2 Carapace strongly depressed, with single obtuse vertebral keel, anterior and posterior margins of the shell reverted, anterior margin not serrated, posterior margin serrated; upper jaw notched; second vertebral shield narrower than second costal ..... *depressa*

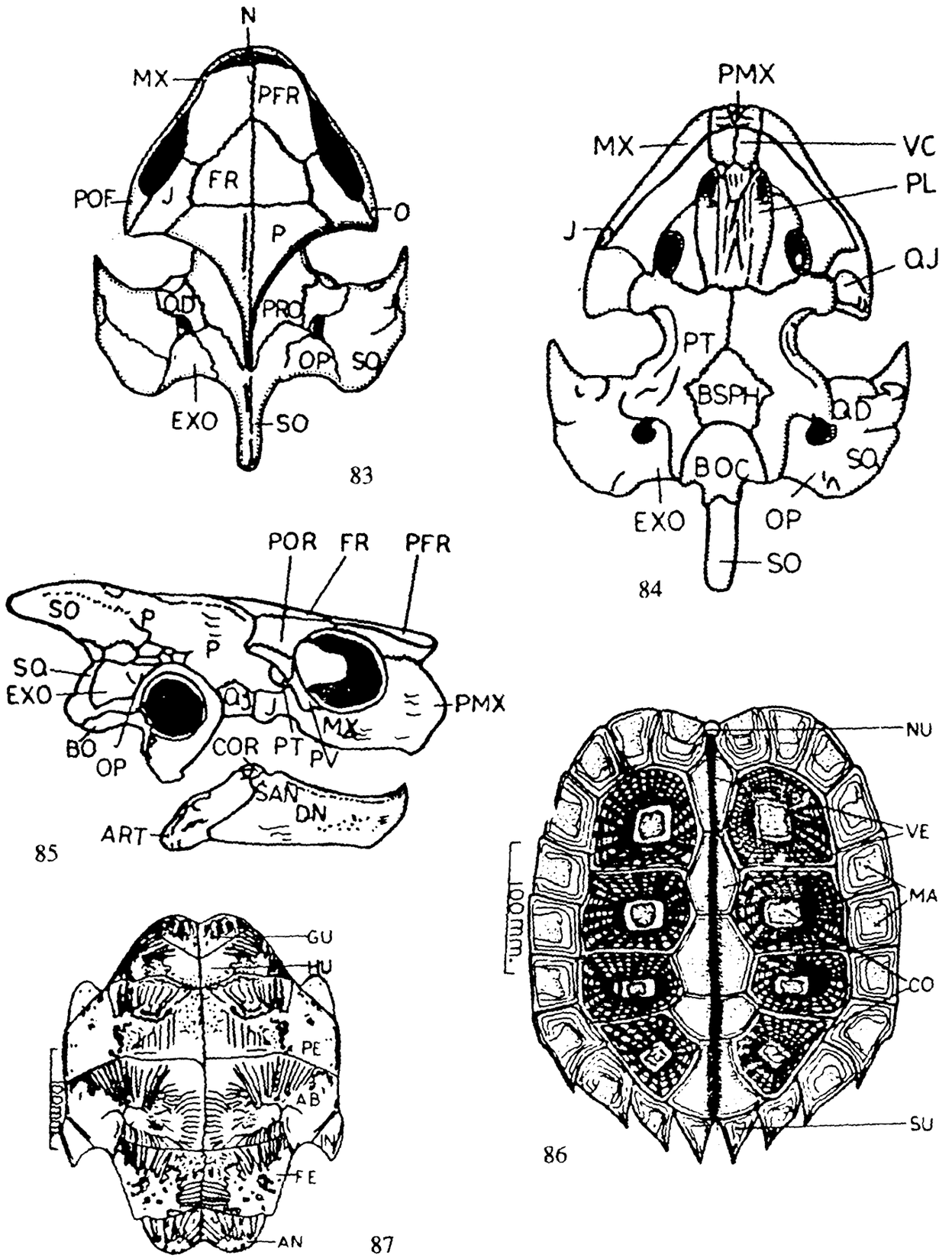
3 Carapace arched, with a strong obtuse vertebral keel, with a reverted and serrated posterior margin, anterior margin not serrated; upper jaw notched; second vertebral shield narrower than second costal ..... *grandis*

10. *Heosemys grandis* (Gray 1860)
(Figs. 83-87)

1860. *Geoemyda grandis* Gray, *Ann. Mag. Nat. Hist.* 6(3) : 218.

1931. *Geoemyda grandis*, Smith, *Fauna Brit. Ind.* 1 : 101-102.

This is a very large turtle whose length in some individuals reaches up to 48 cm. The head is moderately large; snout length never exceeds the orbital length, snout projects beyond the lower jaw; upper jaw hooked, bicuspid; skin on the posterior portion of head is having large shields. Skull (Figs. 83-85) is devoid of bony temporal arch; alveolar surfaces of jaws narrow, without median ridge; choanae on a level with the anterior part of the orbits. Carapace (Fig. 86) is quite broad, almost as broad as long in the juveniles but as the age increases it becomes elongated and somewhat arched in most of the adult individuals; vertebral region is not flat or depressed in the adults but with a strong obtuse keel, lateral keels are generally missing, vertebral region is somewhat depressed in the young individuals, but the vertebral keel is most prominent. The posterior margin of the shell is serrated and somewhat reverted. Nuchal shield is moderately large; first vertebral is generally longer than broad, constricted anteriorly in the adults, the length and breadth of the second, third and fourth vertebral shields is almost equal; all these shields are narrower than the costals and are mesially notched or concave on their posterior margins. Plastron (Fig. 87) is almost as large as the shell opening, angulated on the lateral aspects in the juveniles, rounded in the adults, truncate or angularly emarginate anteriorly; it consists of paried gular, humeral, axillary, pectoral, abdominal, inguinal, femoral and anal shields; hind lobe of the plastron is quite narrow than the shell openning, shorter than the width of the bridge, deeply notched in the posterior region; the longest median suture is between the abdominal shields and the shortest is between the anal, humeral, or gular, the axillary and inguinal shields are small. Limbs are comparatively flattened; front portion of fore- limbs and hinder part of hind-limbs with enlarged, squarish, pointed, horny scales, digits in most individuals are fully webbed. Tail is very short. The measurements in adults include as length of shell 370-435 mm. breadth 250-280 mm. and depth 140-160 mm. The carapace is dark



Figs. 83 – 85. Skull of *Heosemys grandis* (Gray). 83. Dorsal view. 84. Ventral view; 85. Lateral view.

Figs. 86 & 87. *Heosemys grandis* (Gray). 86. Carapace; 87. Plastron.

brown, generally with distinct concentric annulation on each scale and the vertebral keel is paler; plastron is yellowish or brownish; plastral bridges are pale buff; each plastral plate is with rediating dark brown rays; head is greyish or greenish with pink markings which become quite dense on the temporal region; limbs are brown.

Distribution : Burma as far as Pegu; Thailand; Cambodia; and the Malaya Peninsula as far south as Province Wellsley.

Habits and habitat : Habits are terrestrial as well as aquatic and is found both at sea-level and in the hills. The species is omnivorous and its growth rate is fast. Nothing is known about is breeding habits.

Status : The species is quite abundant in throughout its range.

11. *Heosemys depressa* (Anderson 1875)
(Figs. 88 & 89)

1875. *Geoemyda depressa* Anderson, *Ann. Mag. Nat. Hist.* 16 (4) : 284.

1890. *Geoemyda depressa* Boulenger, *Fauna Brit. Ind.* : 25.

1931. *Geoemyda depressa*, Smith, *Fauna Brit. Ind.* 1 : 95.

This is a moderately large turtle whose length rarely exceeds 25 cm. The head is moderately large; snout length is less than the orbital length; snout is truncate; upper jaw bicuspid; skin on the posterior portion of head is having large shields. Skull is devoid of bony temporal arch; alveolar surfaces of jaws narrow, without median ridge; choanae on a level with the anterior part of the orbits. Carapace (Fig. 88) is strongly depressed; its vertebral region is flattened which is provided with a prominent obtuse keel. The posterior margin of the shell is serrated; both the anterior and posterior margins of the carapace are slightly reverted. Nuchal shield is moderately large; length and breadth of the first vertebral are equal; second, third, and fourth are broader than long, all these shields are either equal or narower than the adjacent costals and are mesially notched or concave on their posterior margings. Plastron (Fig. 89) is almost as large as the carapace, truncate anteriorly; hind lobe of the plastron is narrower than the shell-opening, shorter than the width of the bridge, slightly notched in the posterior region; the longest median suture is between the abdominal shields, the shortest is between the humeral or anal shields; axillary and inguinal shields are available. Fore limbs are with enlarged, squarish, pointed, horny scales; mainly on the front. The hind limbs are flattened, the anterior margins and the region of heels are having enlarged horny scales. Fingers are half-webbed. Toes are also provided with shorter webs. Claws are very long and strong. Tail is short. The measurements include as length of the shell 250 mm., breadth 175 mm., and depth 95 mm. The carapace is uniformly light brown above or in many individuals the shields are with dark mottlings. The plastron is yellowish-brown, the plastral shields are with dark blotches or broad rays. According to anderson "head leaden, iris brown; neck and skin of limbs pale yellowish-brown. Large scales of limbs dark, almost black, with brownish margin."

Distribution : Burma (hills of Arakan).

Habits and habitat : A hill species living mainly on the vegetable matter. It is a

fine digger and with the help of its long and powerful claws it makes burrows on the muddy-rocky hillslopes covered with undergrowths and dense forest litter. Nothing is known about its breeding habits.

Status : Not known sufficiently but it is certainly a rare species.

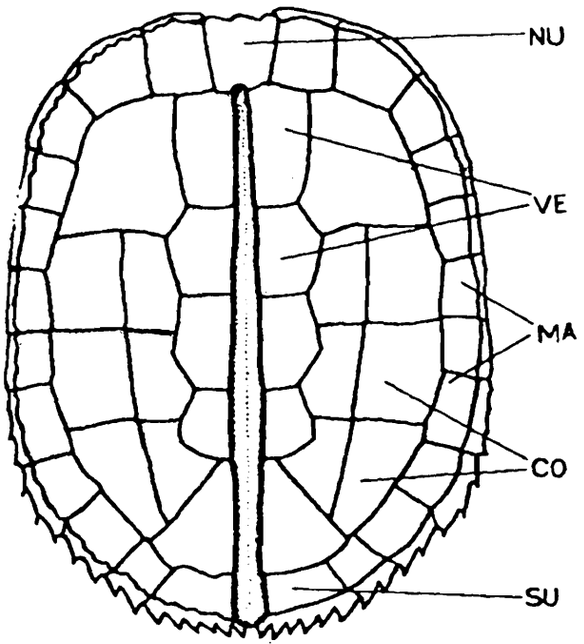
KAVALAI FOREST TURTLE
12. *Heosemys silvatica* (Henderson 1912)
(Figs. 90 &91)

1912 *Geoemyda silvatica* Henderson, *Rec. Ind. Mus.* 7 : 217 (type loc. near Kavalai, Cochin State Forest, S. India; Ind. Mus.)

1931. *Geoemyda silvatica*, Smith, *Fauna Birt. Ind.* 1 : 94.

This is a very small, secretive, freshwater-terrestrial turtle not reaching more than 12 cm. in length. Henderson (1912) originally described this species under genus Geoemyda. Until more material of this species is examined its true affinities are subject to doubt. The head is comparatively large, snout tubelike, truncated anteriorly and is as long as the orbit, upper jaw hooked; mandibular symphysis are very long, longer than the greatest diameter of the orbit. Skin of the posterior portion of head is having moderately large shields. Skull characters are not known fully. Carapace (Fig. 90) is much depressed and is provided with a strong vertebral keel. Two feebly developed keels are present on both the lateral aspects of carapace. The posterior margin of the shell is slightly reverted. Nuchal shield is small; first vertebral shield is broader in front than behind, larger than the second, third, and fourth vertebrals. Second, third and fourth vertebral shields are much broader than long and as broad as the costals. Plastron (Fig. 91) is almost as large as the shell opening and consists of paired gular, humeral, axillary, pectoral, abdominal, inguinal, femoral and anal shields. It angulates laterally, openly emarginate anteriorly and posteriorly and the width of the bridge is less than the length of the hind lobe. The longest medium suture is between the abdominal shields and the shortest suture exists between the gular. The axillary and inguinal shields of plastron are very small. Fore limbs are with enlarged squarish, pointed, horny scales, mainly on the front. The hind limbs are club-shaped, the anterior margins and the region of heels are having enlarged horny scales. Fingers are webbed at the base. Toes are also provided with a rudimentary web-system. Tail is very short. The measurements include as length of shell 120 mm. breadth 83 mm. and depth 45 mm. The carapace is dark brown or bronzy. Plastron is yellow with two distinct deep yellow spots ont he bridge. Upper portion of the forehead and jaws are bright yellow, hinder part of head and neck are brown, limbs and tail are black and top of snout is provided with a red spot.

Habits and habitat : According to the information provided by local tribals and on the basis of original description, this turtle prefers to live in dense upland rain forest up to 500 metres altitude. Turtless live in small burrows on the muddly-rocky hill slopes covered with dense forest litter. The brownish colouration ofthe turtle is most suitable and renders its ability to camouflage in the brownish dry leaves. The species is said to be living entirely on vegetable material. Nothing is known about its breeding habits.



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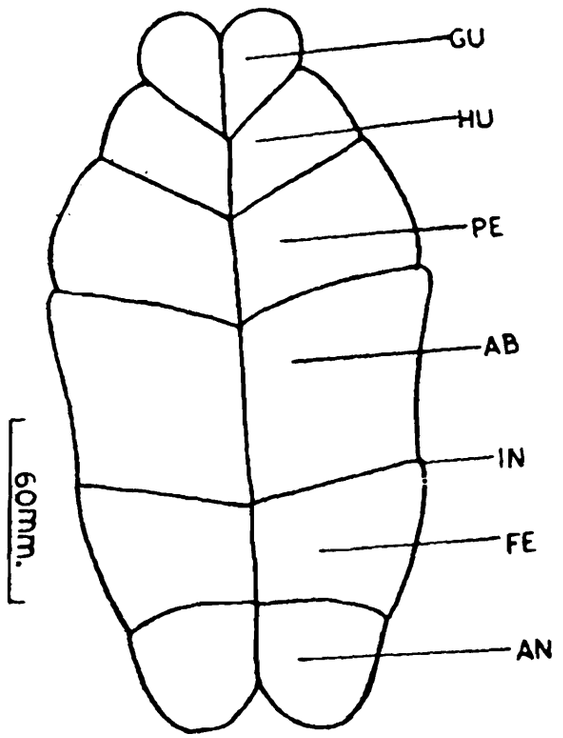

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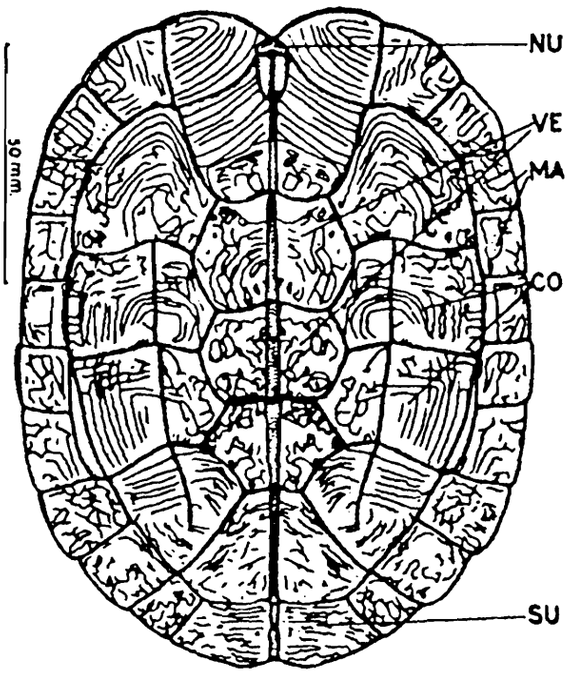

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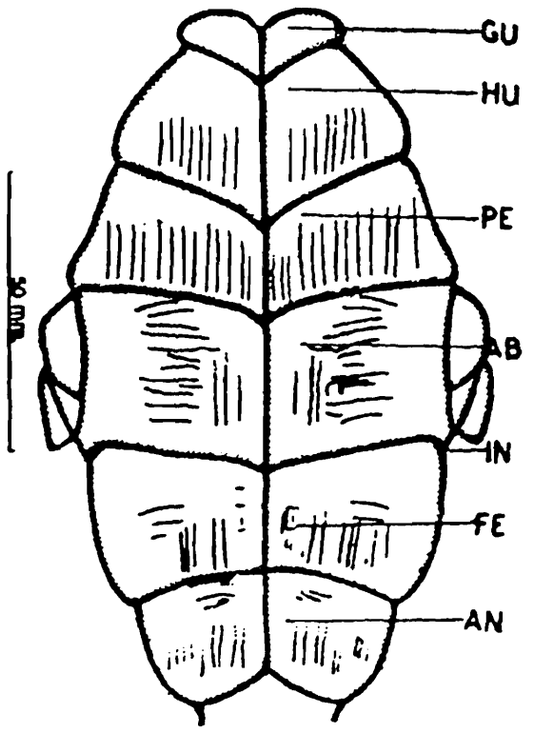

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Figs. 88 & 89. *Heosemys depressa* (Anderson). 88. Carapace; 89. Plastron.

Figs. 90 & 91. *Heosemys silvatica* (Henderson). 90. Carapace; 91. Plastron.

Status : The species is threatened mainly by loss of its rain forest habitat. It is reported by many local tribals that the liver of this turtle is a certain cure and preventive measure for bleeding piles and as such this turtle is killed immediately for the purpose, if traced anywhere in these forests.

Conservation : Though rare, this species still exist in the rain forest area of Kerala. The protection of its habitat will naturally help in the conservation of this small, rare and curious turtle.

Genus 11. ***Melanochelys*** Gray 1869

1869. *Melanochelys* Gray, *Proc. Zool. soc. London*, 187 (*Melanochelys trijuga*)

1931. *Geoemyda*, Smith *Fauna Brit. Ind.* 1 ; 88-89

Carapace is tricarinate; vertebral shields short-sided posteriorly; plastorn united to carapace by a suture. Skull is with a bony temporal arch; squamosal bone is present; ventral end of jugal is narrow alveolar surfaces of jaws narrow, without median ridge; choanae on a level with the anterior portion of the orbit; upper jaw feebly notched at the middle; skin of the hinder part of head divided into very large shields; hind limbs flattened; fingers half webbed, more than half webbed or fully webbed; toes with rudimentary webs. Tail short or very short.

Key to the species

1. Carapace elongate, strongly arched, tricarinate; plastorn is yellow..... *tricarinata*..... 2
2. Carapace depressed, tricarinate; plastorn is blackish, generally with a yellow margin ..... *trijuga*

THREE KEELED TORTOISE

13. ***Melanochelys tricarinata*** (Blyth 1856)

(Figs. 92 & 93)

1856. *Geoemyda tricarinata* Blyth, *J. Asiat, Soc. Bengal*, 24 : 714 (type loc. Chaibase district, Chota Nagpur; Ind. Mus.)

1980. *Chaibassia theobaldi*, Boulenger, Fauna Brit. Ind. : 28.

1931. *Geoemyda tricarinata*, Smith, Fauna Brit. Ind. 1 ; 95- 96

This is moderately small species reaching a length of 17 cm. The head is moderately small, snout shorter than the orbit, truncate, upper jaw feebly notched at the moddle. Skin of the posterior portion of head is divided into large shields. skull is with a slender, thin and incomplete bony temporal arch; alveolar surfaces of jaws are narrow, without median ridge; choanae on a level with the anterior portion of the orbits; squamosal bone is present. The carapace (Fig. 92) is much elongated, arched and with steep sides is fully grown up males; with three obtuse keels; posterior border smooth or feebly serrated. Second neural plate is generally octagonal, other succeding neural plates are narrow on the posterior border. Nuchal shield is not very large; first vertibral sheild is broadest on the anterior margin; second, third, and fourth vertebrals broader than long, narrower than the costal shields. Plastron is intimately attached to the carapace by a suture, with short axillary and inguinal buttresses which reach to the outer margins of the costal plates.

Entoplastron interesected by the humeropectoral suture. Plastron (Fig. 93) usually as long as the carapace, feebly angulated laterally in the juveniles, truncate anteriorly; hind plastral lobe is narrower than the shell opening, longer than the width of the bridge, notched posteriorly; the longest median suture is between the abdominal or the pectoral shields, the shortest between the humeral or the femoral, axillary shield usually present, inguinal shield is usually missing. Limbs are with long clasws, fingers half weebed, toes with rudimentary webs only front part of arms with enlarged, squarish somewhat pointed scales; hind limbs flattened quite large in the grown up males, the anterior margins with keels and enlarged horny scales. Tail is short. Dorsum is dark-plum coloured with light brown keels having dark brown outlines. Ventrum yellowishbrown. Head and limbs dark plum or blackish above; a broad red stripe on each side of the head, starting from the nostril and passing above the eye and the tympanum; a similar band below the angle of the month, along the inferior margin of the lower jaw. Limbs with or without yellow spots.

Distribution : India : Bihar (Chotanagpur), West Bengal (Jalpaiguri district) and Assam (Dafla Hills and Bisnath Plain).

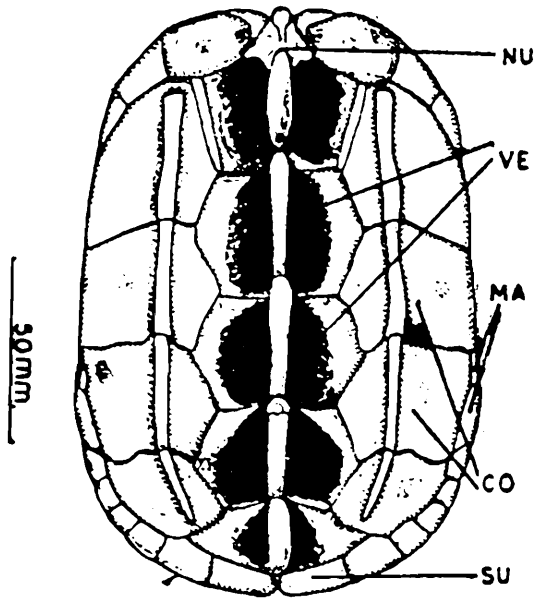
Habits and habitat : The species inhabits the hilly terrestrial areas. It is mainly herbivorous and generally 3 to 6 oval eggs are laid in a single clutch. Egg laying takes place throughout year.

Status : Indeterminate, probably vulnerable. The main threats to the species include large scale exploitation of eggs and adults for food by the local tribals. The habitat diestruction is the anotehr major threat to the survival of this species.

Conservation : As a protective measure the Director, Zoological Survey of India has already proposed for the inclusion of this species in Appendix I of the Indian Wildlife Act, 1972.

Key to the sub species of *Melanochelys trijuga*
Six subspecies are available

1. Carapace light brown to dark brown; plastorn with a yellow border. Head Gray or Olive, with yellow or pink reticulations ..... *Melanochelys trijuga trijuga* 2
2. Carapace dark brown or black; plastorn with a yellow border. Head gray or brown ..... *Melanochelys trijuga edeniana* 3
3. Colouration similar to *Melanochelys trijuga edeniana* but attains a larger size ..... *Melanochelys trijuga indopeninsularis* 4
4. Carapace top of head and front of the snout almost black; temporal region yellow *Melanochelys trijuga coronata* 5
5. Carapace reddish - brown or black; plastral margin and keels yellow. Head black with red or orange spots ..... *Melanochelys trijuga thermalis* 6
6. Carapace black; plastron dark brown with dirty yellow lateral borders. Head olive brown, with orange spots in some individuals .... *Melanochelys trijuga parkeri*



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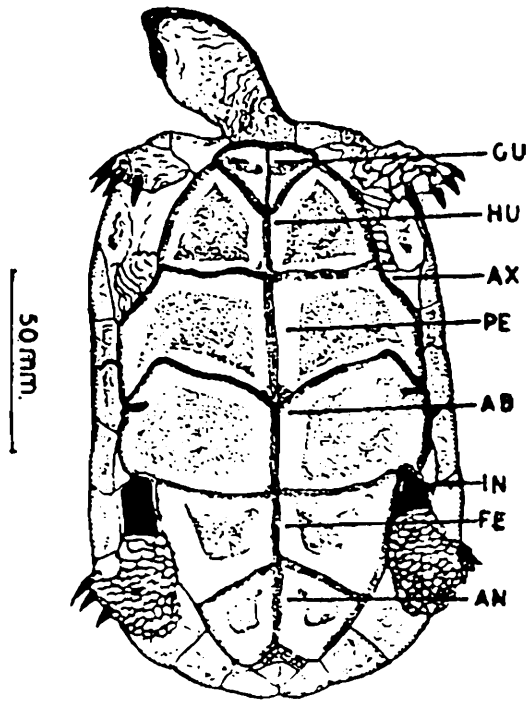

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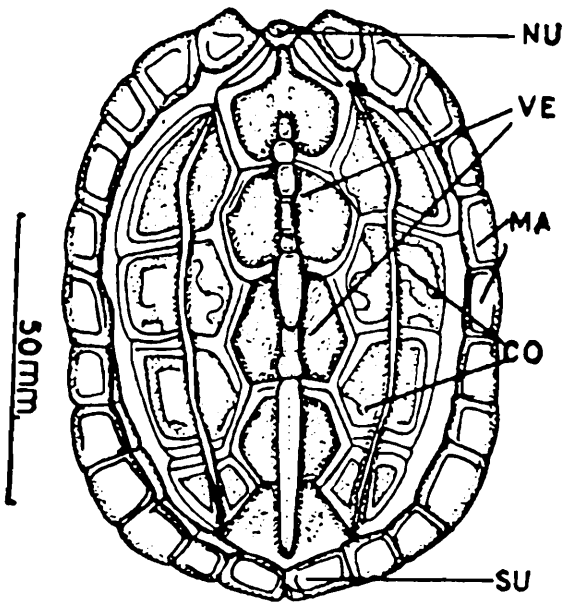

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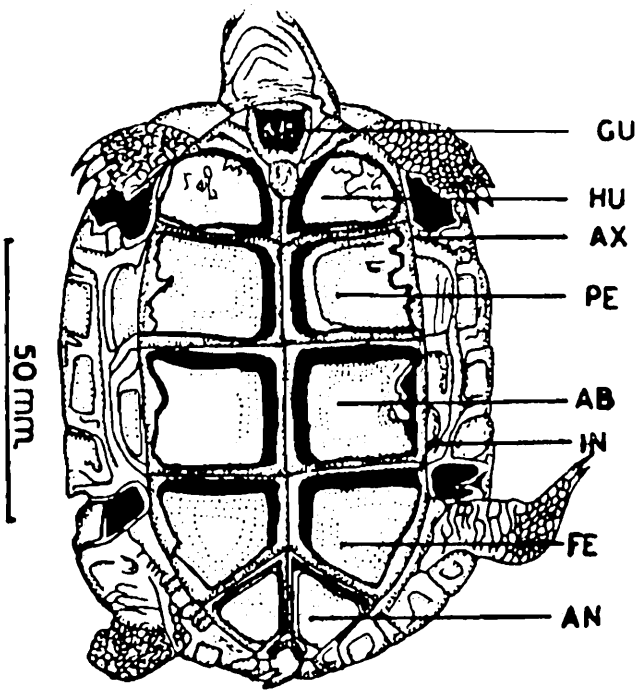

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Figs. 92 & 93. *Melanochelys tricarinata* (Blyth). 92. Carapace; 93. Plastron.
Figs. 94 & 95. *Melanochelys trijuga trijuga* (Schweigger) 94. Carapace; 95. Plastron.

INDIAN SNAIL-EATING TURTLE
14. *Melanochelys trijuga trijuga* (Schweigger 1814)
(Figs. 94 &95)

1814. *Emys trijuga* Schweigger, *Prodr. Monog.* Chel. 41 (type loc. Java)

Six well defined and perfectly established subspecies of *Melanochelys trijuga* are available in India (distribution shown in the accompanying map). These races are mainly recognised on the basis of hèad and shell colouration.

Size of this sub-species is moderate, reaching up to a length of 23 cm. or slightly more. The head is moderately small, shorter than the orbit, slightly projecting beyond the lower jaw; upper jaw notched at the middle. Skin of the posterior portion of head smoothbut divided into large shields. Skul is with a bony temporal arch, which is sometimes incomplete posteriorly; alveolar surfaces of jaws are narrow, without median ridge; choanae on a level with the anterior portion of the orbits; squamosal bone is present. The carapace (Fig. 94) is moderately depressed, tricarinate, the lateral margins slightly reverted, the posterior margin feebly serrated in the young. Nuchal is moderately small; vertebral shields are quite variable both is shape and proportions, as long as broad or longer than broad in the adult, slightly narrower than the costals. Plastron (Fig. 95) is intimately attached to the carapace by a suture, with short axillary and inguinal buttresses which reach to the outer margins of the costal plates.

Entoplastron intersected by the humero-pectoral suture. Plastron is almost as long as the carapace, truncate and openly emarginationg anteriorly; hind plastral lobe is narrower than the shell opening, generaly shorter than the width of the plastral bridge, deeply notched posteriorly; the longest median suture is between the abdominal shields or the pectoral shields, the shortest median suture is between the humeral shields. Axillary and inguinal shields are present. Limbs are flattened and with completely webbed digits; front of arm and hinderpart of leg with enlarged horny scales. Tail very short in comparison to the body. Dorsum light brown in the juveniles and dark brown to blackish in the adults. The plastron has a yellow margin which reduces in width by the advancement of age. Lateral keels are yellow in the young. Head is greysh or olivaceous with yellow or pink reticulations which are more prominent on the sides; these markings becomes obscured with the advancement of age.

Distribution : India : Goa, Karnataka, Kerala, Maharashtra and Tamil Nadu. It inhabits mainly the central portion of Indian peninsual.

Habits and habitat : This subspecies is mainly aquatic and completely vegetarian in habits. Nothing is known about the breeding habits.

Status : Indeterminate, possibly vulnerable. The main threat to the subspecies is due to large scale exploitation of eggs and adults for food. The habitat destruction also has an impact on the decline of this turtle.

Conservation : Suitable conservation measures have not so far been implemented for the protection of this turtle. This subspecies must be included in Appendix I of the Indian Wildlife Act.

BURMESE VEGETABLE-EATING TURTLE
14a. *Melanochelys trijuga edeniana* Theobald 1876

1876. *Melanochelys edeniana* Theobald, *Cat. Rept. Brit. Ind.* 12 (type loc. Burma; Ind. Mus.)

1879. *Emys trijuga* var. *burmana*, Anderson, *Zool. Res. W. Yunnan*, 723 pls. 67, 68 (type loc. Bhamo, Burma; Ind. Mus.).

1931. *Geoemyda trijuga edeniana*, Smith, *Fauna Brit. Ind.* 1 : 98- 99.

Size of this subspecies is moderate, reaching up to a length of 28 cm. and comparatively larger than the typical one i.e. *Melanochelys trijuga trijuga*. Taxonomic characters are the same as available in the typical subspecies except that it differes in colouration. Dorsum is dark brown in the juveniles but black in the grwon up individuals. The margin of the plastron and the keels are generally yellow. Head is uniformly grey or brown or with faint yellowish reticulations, which disapper after certain age. The measurements include 280 mm. in length, 200 mm. in breadth and 115 mm. in depth.

Distribution : Burma (Arakan; Karenni Foot hills; Moulmein). Available throughout in Irrawaddy River.

Habits and habitat : The species is mainly aquatic and completely vegetarian in diet. According to Anderson it feeds mainly on water plants like Vallisneria and lays a number of oval eggs at one time, burying them a little way under-ground.

Status : Indeterminate, possibly vulnerable.

14 b. *Melanochelys trijuga indopeninsularis*
(Annandale 1913)
(Figs. 96 & 97)

1913. *Geoemyda indopeninsularis* Annandale, *Rec. Ind. Mus.* 9 ; 71, pls. v & vi.

1931. *Geoemyda trijuga indopeninsularis*, Smith, *Fauna Brit. Ind.* 1 : 99.

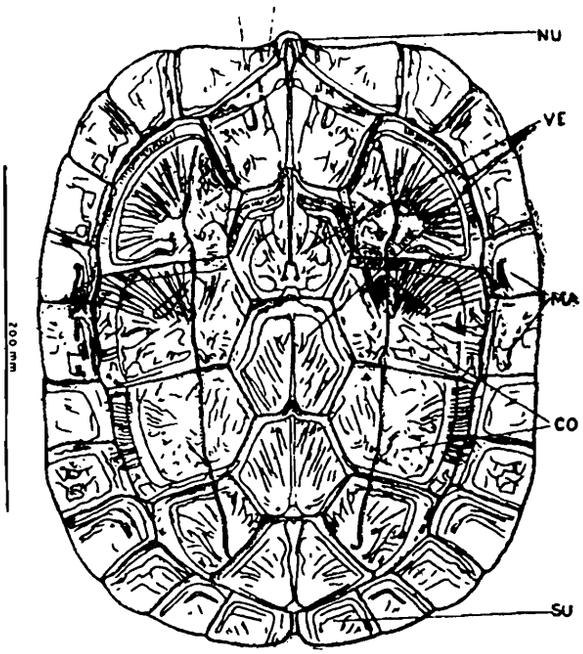
This is a comparatively larger subspecies of turtle in which the shell reaches up to a length of 34 cm. Taxonomic characters are the same as available in *M. trijuga trijuga* except that it differes in colouration. Dorsum dark brown in the juveniles but deep black in the adults. Vertebral keels and plastral margins are yellow. Head grey or brownish, youngs with yellow reticulation but adults are devoid of such markings.

Distribution : India : Bihar (Chotanagpur) and West Bengal (Jalpaiguri District).

Habits and habitat : Mainly aquattic but at ease on the land also. It is herbivorous and food comprises the grass, vegetables and fruits. Nothing is known about the breeding habits of this subspecies.

Status : Indeterminate, possibly has become vulnerable on account of habitat destruction and large scale exploitation of eggs and adult individuals for food by the local tribals.

Conservation : Suitable conservation measures have not yet been followed. This subspecies must be included in Appendix I of the Indian Wildlife Act.



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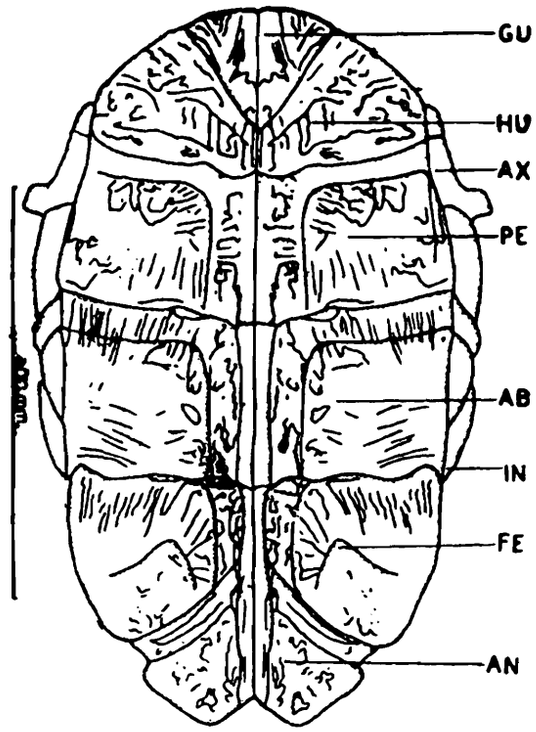

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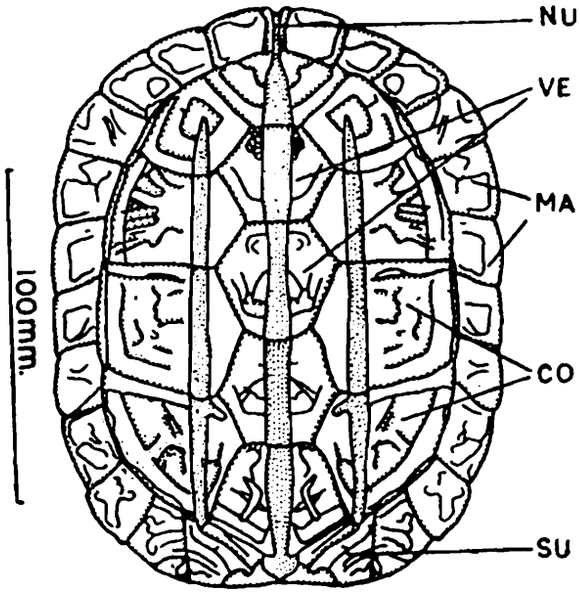

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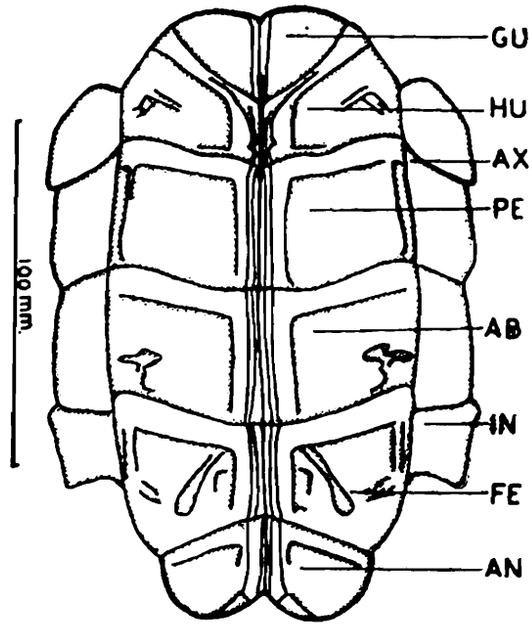

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Figs. 96 & 97. *Melanochelys trijuga indopeninsularis* (Anandale). 96. Carapace; 97. Plastron.
Figs. 98 & 99. *Melanochelys trijuga coronata* (Anderson). 98. Carapace; 99. Plastron.

TRAVANCORE VEGETABLE-EATING TURTLE
14c. *Melanochelys trijuga coronata* (Anderson 1879)
(Figs. 98 &99)

1879. *Emys trijuga* var. *coronata* Anderson, *Zool. Res.* w. *Yunnan*, 729 (type loc. Travancore).

1931. *Geoemyda trijuga coronata*, Smith, *Fauna Brit. Ind.* 1 : 99.

This is a small turtle in which the length never exceeds 18 cm. Taxonomic characters are the same as available in *M. trijuga trijuga* except that it differs in colouration. Complete dorsum and ventrum is dark brown or almost black without markings or spots. Top of the head and front of the snout black, temporal region is yellow and the rest of the head is olivaceous.

Distribution : India : Kerala (Cochin, Calicut)

Habits and habitat : Mainly aquatic and herbivorous. Nothing is known about its breeding habits.

Status : Intermediate, possibly has become vulnerable on account of habitat destruction and large scale exploitation of eggs and adult individuals for food by the local tribals.

Conservation : Suitable conservation measures have not so far been implemented. This subspecies must be included in Appendix I of the Indian Wildlife Act.

SRI-LANKAN VEGETABLE-EATING TURTLE
14d. *Melanochelys trijuga parkeri* Deraniyagala 1939

1931. *Melanochelys trijuga parkeri* Smith, *Fauna Brit. Ind.* 1 : 99.

1939. *Melanochelys trijuga parkeri* Deraniyagala, *The tetrapod reptiles of Ceylon, Colombo,* 1-412.

This is the largest subspecies of genus *Melanochelys*, reaching up to a length of 43 cm. Taxonomic characters are the same as available in the typical form except that it differs in size and colouration and the dorsal keeps are not distinct in adults. The dorsal colouration is uniformly black. The plastron is dark brown, usually with a dirty yellow lateral border. The head colouration is uniform olive-brown but in few individuals head is finely spotted with orange.

Distribution : Sri Lanka.

Habits and habitat : The species is perfectly vegetarian and found both on land and in still water.

Status : Indeterminate, possibly vulnerable.

INDO-SRI-LANKAN VEGETABLE-EATING TURTLE
14e. *Melanochelys trijuga thermalis* (Lesson 1830)
(Figs. 100 & 101)

1830. *Emys thermalis* Lesson, *Cent. Zool.* 86, pl. 29 (type loc. Ceylon).

1870. *Melanochelys sebae* Gray, *Cat. Sh. Rept.* 1 : 34 (type loc. Ceylon and India; Brit. Mus.).

1931. *Geoemyda trijuga thermalis*, Smith, *Fauna Brit. Ind.* 1 : 99-101.

This is moderately large turtle in which length of the shell reaches up to 22 cm.

Taxonomic characters are the same as available in the typical form except that it differs in colouration. Black all over, darkness is comparatively less at the sides of the plastron and along the dorsal keels but the keels are yellowish. Hard dark black with orange or reddish spots and reticulations in the young individuals. In the aged adults the head remains absolutely black.

Distribution : India : Tamil Nadu (Ramnad District). Elsewhere : Maldive Islands and Sri Lanka.

Habits and habitat : These turtles prefer to live in ponds and occasionally bask on stones and logs projecting from the water. They are equally comfortable on land also and sometimes are found far away from water. The sub-species is absolutely herbivorous. It digs a small nets-pit about 7 or 8 cm. deep and deposits there about three to five eggs in a single clutch. The eggs range from 43-45 mm. in length and 24-27 mm. in width. Breeding takes place throughout the year and a single female lays from three to five times during that period.

Status : Indeterminate, possibly has become vulnerable on account of habitat destruction and large scale exploitation of eggs and adults for food.

Conservation : Suitable conservation measures have not yet been followed. This subspecies must be included in Appendix I of the Indian Wildlife Act.

Genus 12. *Geoclemys* Gray 1855

1855. *Geoclemys* Gray (in part), *Cat. Sh. Rept.* 1 : 17 (*Geoclemys hamiltonii)*

1889. *Damonia* Boulenger (in part), *Cat. chel. Brit. Mus.* 92.

1931. *Geoclemys* Smith, *Fauan Brit. Ind.* 1 : 111.

The main generic characters are : Vertebral shields short-sided anteriorly plastron united to carpace by a suture; axillary and inguinal buttresses are short, do not extend even half way along the costal plates; entoplastron is anterior to the humero- pectoral suture. Skull is with a bony temporal arch, quadro-jugal is separated from the post-orbital by the jugal. Alveolar surfaces of jaws are very broad and is devoid of median ridge; bony choanae on a level with the posterior portion of the orbits; skin of the posterior portion of head is divided into prominent shields. Digits are fully webbed. Tail very short, not longer in the juvenile than in the adult. This genus is monotype.

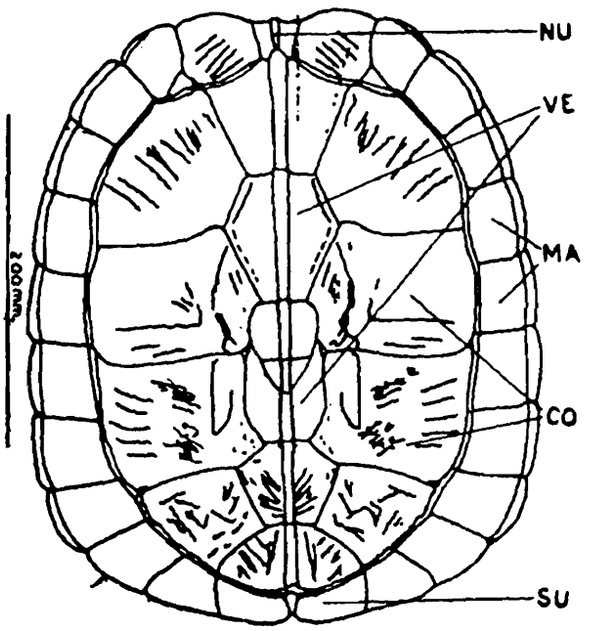
NORTH INDIAN FRESHWATER TORTOISE
OR
BLACK-SPOTTED POND TURTLE
15. *Geoclemys hamiltoni* (Gray 1831)
(Figs. 102 &103)

1831. *Emys hamiltoni* Gray, *Syn. Rept.* 21 & 72 (type loc. India).

1885. *Clemmys palaeindica*, Lydekker, *Paleont. Ind.* 3 (10) : 178, pl. 21.

1931. *Geoclemys hamiltoni*, Smith, Fauna *Brit. Ind.* 1 : 111 & 112

This is fairly large species reaching up to 31 cm. in length. The head is large, broad, snout rounded, as long as the orbit and slightly projecting beyond the lower



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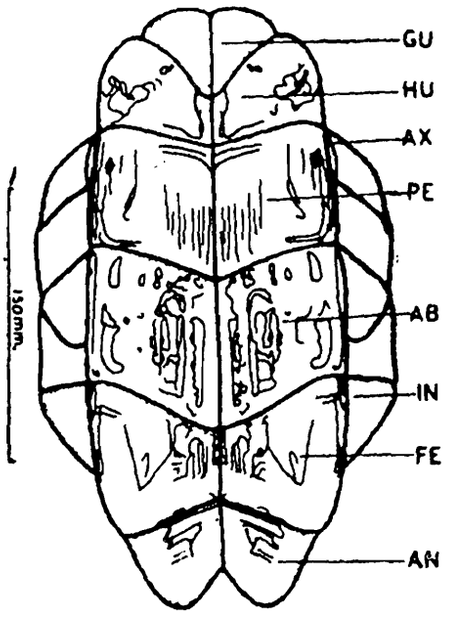

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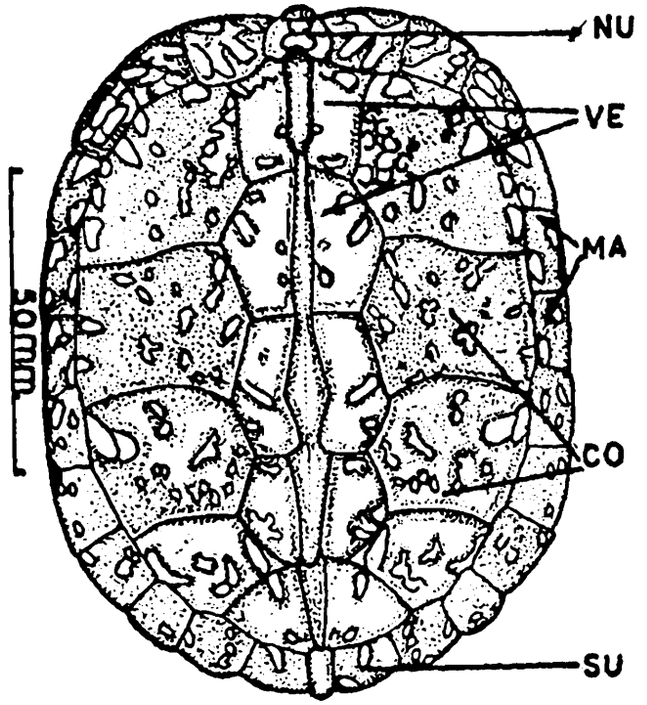

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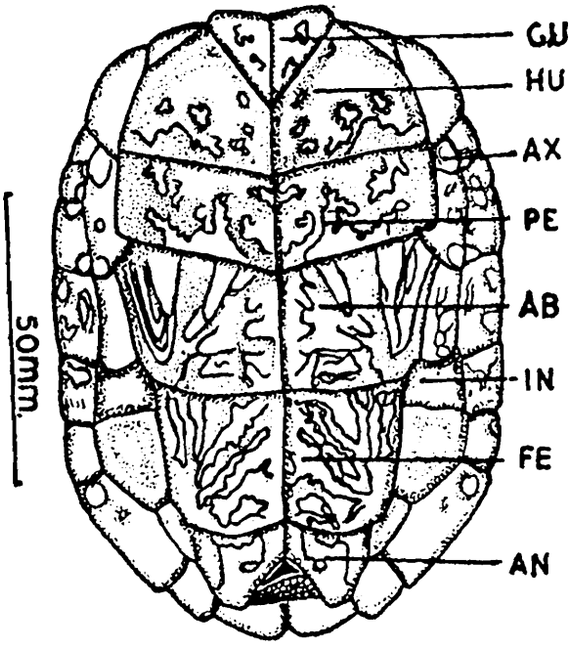


103

Figs. 100 & 101. *Melonochelys trijuga thermalis* (Lesson) 100. Carapace; 101. Plastron.
Figs. 102 & 103. *Geoclemys hamiltoni* (Gray). 102. Carapace; 103. Plastron.

jaw. Skin of the posterior portion of head is divided into large shields. Skull with a bony temporal arch, the qudadrato-jugal being separated from the postorbital by the jugal. Alveolar surfaces of jaws very broad, without median ridge; bony choanae on a level with the hinder part of the orbits; the upper jaw broadly emarginate in the middle. The carapace (Fig. 102) is tricarinate, strongly convex with three interrupted keels in addition to the vertebral and costal keels; posterior margin serrated. The nuchal shield is not very large, broadest at the posterior aspect. First vertebral shield longer than broad; second and third vertebrals broader than long in juveniles, about as broad as long in the adult individuals but these are narrower than the costals. The Plastron (Fig. 103) consists of paired gular, humeral, axillary, pectoral, abdominal, inguinal, femoral and anal shields. Plastron intimately attached to the carapace by suture, axillary and inguinal buttresses are strong but short andextend only up to the outer ends of the costal shields. Entoplastron is situated quite anterior to the humeropectoral suture. Plastron is almost equal to the carapace in length, angulate laterally, truncate anteriorly, posterior plastral lobe is much narrower than the opening of the shell and as long as the width of the plastral bridge, deeply notched posteriorly, the longest median suture is between the abdominal shields and shortest between the anal or the humeral, axillary and inguinal shields large. Limbs are with fully webbed digits and have transversly enlarged scales. Tail quite short in comparison to body, covered below with small granular scales. General dorsal colouration is dark brown to black and richly spotted and streaked with deep yellow. Soft parts dark brown to black with numerous round yellow spots which are largest on the head and neck.

Distribution : India : Ganga and Sind river systems. Elsewhere : Pakistan (Sind). Fossils have been recorded from the Siwalik Hills.

Habits and habitat : The specieds is absolutely aquatic and prefers to live in quite shallow and clear water with plenty of aquatic vegetation. This is carnivorous turtle and its diet mainly consists of snails. In captivity it relishes raw meat and fish but rejects any vegetable matter. Nothing is known about its breeding habits.

Status : The species is extremely vulnerable. This turtle was fairly abundant in the early 20th century from Sind to Bengal but in recent years the species has been depleted drastically all over its range, owing to the over exploitation of eggs and adult individuals for food. Habitat destruction constitutes the second most significant threat to the survival of this species. Nesting area are lost for commercial removal of sand on the one hand, and cleaning of riverside aquatic vegetation on the other. This causes scarcity of food sources and exposes the banks to soil erosion. The construction of hydro-electric dams and barrages has checked the movement of the species to its nesting sites during breeding seasons.

Conservation : Nominally protected by legislation throughout its range.

Genus 13. *Morenia* Gray 1870

1870. *Morenia* Gray, *Cat. Sh. Rept.* Suppl. 1 : 62 (type *Emys berdmorei* Blyth)

1890. *Morenia* Boulenger, *Fauna Brit. Ind.* 35.

1931. *Morenia*, Smith, *Fauna Brit. Ind.* 1 : 119.

Vertebral shields short-sided anteriorly; Axillary and inguinal buttresses are

weak and short but extend to the outer margins of the costal plates, skull is with a bony temporal arch; quadrato- jugal remains in contact with the jugal and postorbital; alveolar surfaces of jaws are very broad and the upper jaw is with a strong median ridge; choanae on level with the posterior margin of the orbits; carotid canal entirely within the pterygoid; chamber for paracapsular sac is not completely open posteriorly; plastron united to carapace by a suture; entoplastron in anterior to the humeropectoral suture. Skin of the posterior portion of head is transversely striated. Digits are fully webbed. Tail is short.

Key to the species

1. Snout shorter than the orbit; generally not projecting beyond the lower jaw; breadth of the nuchal shield is one-fourth that of the adjacent marginal ..... *ocellata*
2. Snout length is equal to the orbit length; snout projects beyond the lower jaw; breadth of the nuchal shield is half of the adjacent marginal ..... *petersi*

16. ***Morenia ocellata*** (Dumeril & Bibron 1835)
(Fig. 104)

1835. *Emys ocellata* Dumeril & Bibron, *Erp. Gen.* 2 : 329, *pl.* 15 (type loc. "Bengal"; *Paris Mus. Nat. Hist*).

1890. *Morenia ocellata* Boulenger, *Fauna Brit, Ind.* : 35.

1931. *Morenia ocellata* Smith, *Fauna Brit, Ind.* 1 : 120.

This is a small turtle whose length rarely exceeds 23 cm. The head is moderate in length and size; snout length is shorter than the orbital length; snout slightly projects beyond the lower jaw; upper jaw is notched in the middle; lower jaw is flat ventrally and is provided with a large oval plate on either side near the angle of the mouth; skin on the posterior portion of head is having transverse striations. Skull is with a bony temporal arch; quadrato-jugal remains in contact with the jugal and post-orbital; alveolar surfaces of jaws are very broad and the upper jaw is with a strong median ridge; choanae on a level with the posterior margin of the orbits; cartoid canal entirely within the pterygoid; chamber for paracapsular sac is not completely open posteriorly. The carapace (Fig. 104) is convex, moderately dommed; convexity of carapace is more in the females in comparison to the males; carapace in the juveniles is with an interrupted, rod-like, vertebral keel, which becomes less prominent in the adults; posterior margin of the carapace is not serated. Nuchal shield is moderately large, twice, as long as broad in adult turtles; the first vertebral shield is subquadrangular and its lateral margins are generally curved; second to fourth vertebral shields are slightly broader than long but rarely may be as broad as long in few adult individuals, these shields are not as broad as the costal shields. The plastron is nearly as long as the carapace; angulate on sides; truncate anteriorly; united to carapace by a suture; hind plastral lobe is narrower than the opening of the shell, it is shorter than the width of the bridge and notched posteriorly; entoplastron is anterior to the humeropectoral suture; the longest median suture is between the abdominal or the pectoral shields, the shortest is between the gular or the femoral; axillary and inguinal shields are large. Digits are fully webbed; limbs with narrow curved scales; Tail is

short. The measurements in adults include as length of shell, 155-210 mm.; breadth, 110-150 mm.; depth 65-95 mm. The carapace is light or dark-olive brown in colour, with a large pale spot on each shield (each spot is with a dark-brown centre and slightly faded margin). Plastron is yellow and is devoid of spots. Head is olive or brownish, with pale yellow streaks, one from the tip of the snout passing above the eyes and reach up to the neck, another streak starts from the posterior border of the eyes and reaches up to the tympanum. Limbs are olive or brownish.

Distribution : Burma (Tenasserim, Toungoo to Mergui)

Habits and habitat : The species is extremely aquatic, but can survive in the terrestrial habitats for a considerable period during the dry season. Nothing is known about its breeding habits but its main food comprises the aquatic vegetable matter.

Status : The species has become extremely vulnerable. The population is towards the constant decline in the recent years on account of large scale exploitation for food in southern Burma when the turtles are left dry in hot weather in drying water bodies, they are captured by the Burmese in large scale for food. These turtles are also imported in other countries for making curios.

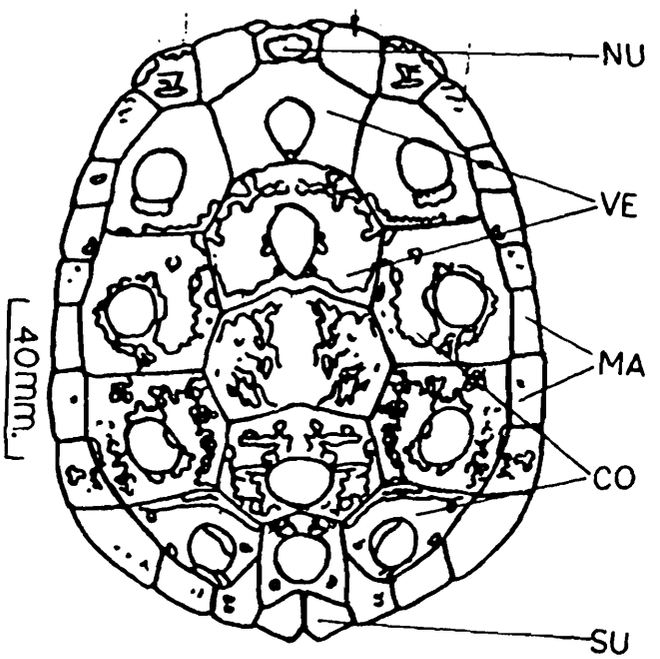
17. *Morenia petersi* (Anderson 1879)
(Figs. 105 & 106)

1879. *Batagur (Morenia) petersi* Anderson, *Anat. Zool. Res. W. Yunnan*, 761, pl. 59 (types in Ind. Mus.)

1890. *Morenia petersi* Boulenger, *Fauna Brit. Ind.* : 36.

1931. *Morenia petersi* Smith, *Fauna Brit. Ind.* 1 : 121—122.

This small turtle rarely exceeds 20 cm. in length. The head is moderate in length and size; snout strongly projects beyond the lower jaw; upper jaw is notched in the middle; lower jaw is flat ventrally and is provided with a small oval plate on either side near the angle of the mouth; skin on the posterior portion of head is having transverse striations. Skull is with a bony temporal arch; quadrato-jugal remains in contact with the jugal and post-orbital; alveolar surfaces of jaws are very broad and the upper jaw with a strong median ridge; choanae on a level with the posterior margin of the orbits; carotid canal sac is not completely open posteriorly. The carapace (Fig. 105) is convex, moderately doomed; carapace is with an interrupted, rod-like, vertebral keel; posterior margin of the carapace is not serrated. Nuchal shield is large and much wide, longer than broad; first vertebral shield is square shaped (as long as broad); second, third and fourth vertebral shields are broader than long and are not as broad as the costal shields. The plastron (Fig. 106) is nearly as long as the carapace; angulated on sides; truncate anteriorly; united to carapace by a suture; hind plastrai lobe is narower than the opening of the shell, it is shorter than the width of the bridge and notched posteriorly, entoplastron is anterior to the humeropectoral suture; the longest median suture is between the abdominal shields or the pectoral shiels are large. Digits are fully webbed; limbs with narrow curved scales; Tail is short. The measurements in adults include as length of shell, 125-183 mm.; breadth, 85-125 mm.; depth, 55-82 mm. The carapace is olive or black in colour, the vertebral and costal shields are with pale green or yellow border; first four vertebral shields are with a



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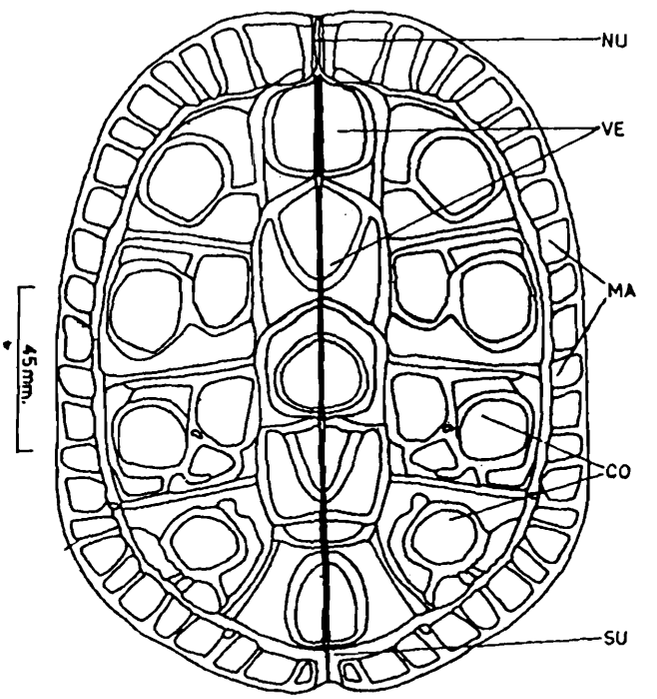

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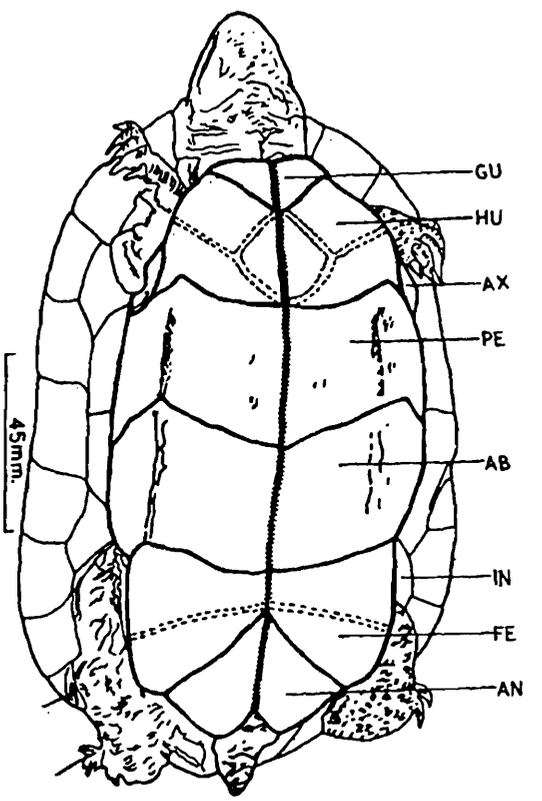


106

Fig. 104. Carapace of *Morenia ocellata* (Din. & Bibr.)

Figs.105&106. *Morenia petersi* (Anderson). 105. Carapace; 106. Plastron.

narrow, pale green, longitudinal stripe and a U-shaped mark, the ends directed forwards; each costal and the last vertebral bear a large pale green circle placed low down, with irregular looped lines of similar colour above; marginal shields are with a pale green mesial streal. Plastron is yellow or orange, the axillary shield and fourth, fifth, and sixth marginals with a dark centre. Top and sides of head are very dark olive with three yellow streaks, one bordering the top of the head, one behind the eye and one below it starting from the tip of the snout. Limbs bordered with yellow.

Distribution : Bangladesh (Dacca, Jessore and Fathegarh).

Habits and habitat : The species is extremely aquatic but quite fond of basking on sandy river banks. Food comprises mainly the aquatic vegetarian. Nothing is known about its breeding habits.

Status : The species is extremely vulnerable on account of its large scale exploitation for food in Bangladesh.

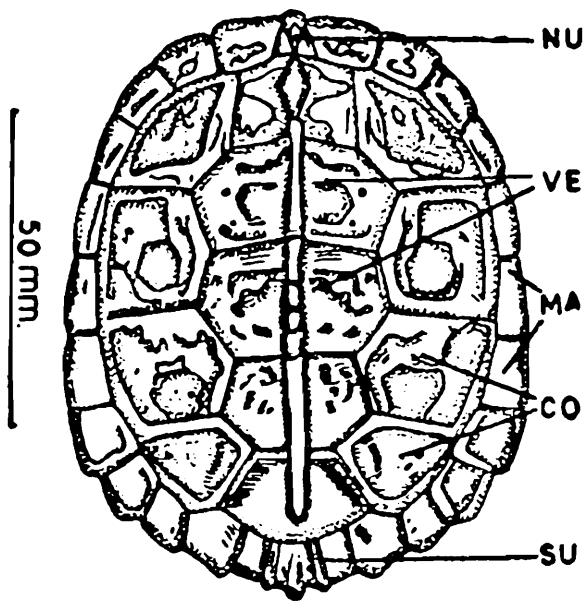
Genus 14. *Hardella* Gray 1870.

1870. *Hardella* Gray, *Cat. Sh. Rept.* Supp. 1 : 58 (type *Emys thurgi*)

BRAHMINY RIVER TURTLE
18. *Hardella thurgi* (Gray 1831)
(Figs. 107 & 108)

1831. *Emys thurgi* Gray, *Illus. Ind. Zool.* 1 : pt. 7

This is a most interesting completely aquatic river tortoise showing extraordinary sexual dimorphism. Its females reach to a lenth of 65 cm. while males attain a maximum length up to 20 cm. The head is moderately large with a pointed and extremely porjecting snout. The skin of the posterior portion of head is divided into a large number of small scales arranged in transverse rows. The skull is with a bony temporal arch. The quadrotojugal is in contact with the jugal and post-orbital; carotid canal lies between pterygoid and prootic; the chamber for paracapsular sac completely opens posteriorly; alveolar surface of jaws is very broad and provided with a strong ridge in the middle; margins of jaws strongly denticulated and upper jaw is bicuspid. The carapace (Fig. 107) is moderately depressed the unicarinate and the posterior portion of each vertebral shield has a knob-like structure. Vertebrals are elongate, somewhat hexagonal with a short anterior margin. The posterior margin of the carapace is slightly serrated. Nuchal shield is not very large and is broadesh posteriorly. The first vertebral is generally longer than broad and its anterior margin is shorter than the posterior. Second to fourth vertebrals are as broad as long and much narrower than costals in the adult specimens. The plastron (Fig. 108) consists of paired gular, humeral, axillary, pectoral, abdominal, inguinal, femoral and anal shields. It is almost as long as the carapace, angulate laterally in juveniles, truncate anteriorly; its hind lobe is much narrow than the opening of the shell, considerably shorter than the width of the bridge, notched posteriorly, the longest medina suture is between the abdominal shields; the shortest between the gular, axillary and inguinal shields large. Plastron is intimately united to carapace by a suture. The axillary and inguinal buttresses are very prominent and extend almost to the vertebrals. The axillary is connected with the first rib. Entoplastron is situated anterior to the humeropectoral



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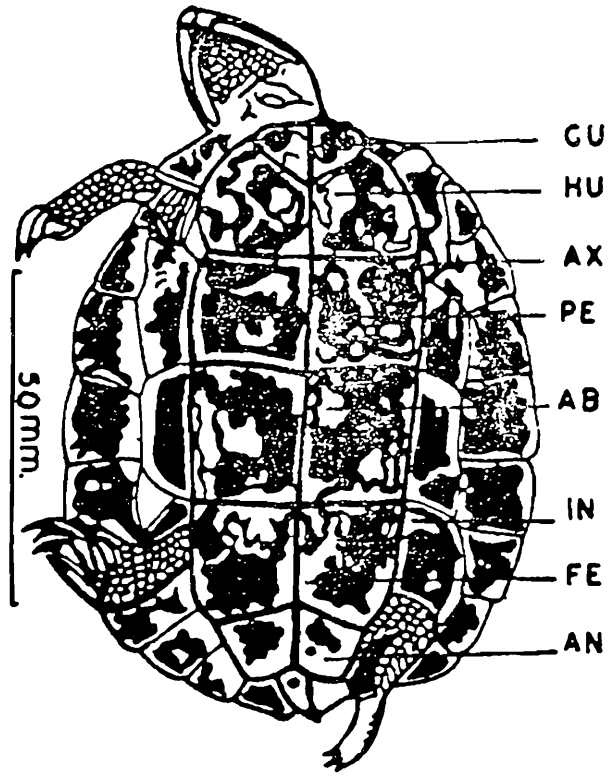

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Figs.107&108. *Hardella thurgi* (Gray). 107. Carapace; 108. Plastron.

suture. Limbs are with fully and broadly webbed digits and have narrow transversely enlarged scales. Fore limbs are provided with five claws. Tail remains quite short throughout life and exhibits no difference in juveniles and adults. General dorsal colouration is dark brown- black with a yellow margin in juveniles and adults. This yellow margin fades out in very large and aged individuals. The keel and the inner margins of the first three costals are blackish to dark black. Venturm is pale yellow with two large black spots on each side on the plastral bridge. Anterior mid portion of the plastron is with a blackish tinge. Abdominal scutes are with large black spots. Other parts of the plastron are also spotted with black. Head is dark-brown to black; curved orange yellow bands are present on the top of the snout, below the nostrils up to eyes, behind the eyes emerging on the neck above the tympanum and along the rami of the lower jaws. Limbs are brownish, margined with yellow behind.

Distribution : India : Ganga, Brahmaputra river systems. Pakistan : Sind river system. Bangladesh.

Habits and habitat : It is entirely aquatic inhabinting stagnant ponds, canals and backwaters and hardly emerges for basking. The Brahminy river turtle generally avoids fast flowing water. The species is entirely herbivorous and devours fruits and vegetables. The species is most docile and never bites even on rough handling. Eggs are oval and look exactly like the hen's eggs.

Status : The species is extremly vulnerable. The main threat to the species is through over-exploitation of adults and their eggs by animal predators and man for

food and habitat destruction. Its flesh is consumed on a very large scale throughout its range and is said to be excellent. Large numbers of Brahminy turtles are still brought into markets in Bengal and their flesh is sold for food.

Conservation : Generally protected by legislation throughout its range but the conservation measures are not effective in many areas. Conservation and management of the species has the potential to provide a vaulable protein-rich food source for the people of India and Pakistan, if suitable programmes of sustained utilization are followed.

Genus 15. *Kachuga* Gray 1869

1869. *Kachuga* Gray, *Proc. Zool. Soc. Lond.* 186, 200 (type *Kachuga trilineata*).

1870. *Emia*, Gray, *Cat Sh. Rept.* Suppl. 1 : 61 (type *Batagur smithii*).

1931. *Kachuga* Smith, *Fauna Brit. Ind.* 1 : 124.

Neural body shields are hexagonal with a shorter anterior aspect. There is an intimate sutural connection between the carapace and platron. The axillary and inguinal buttresses of plastron are strongly developed and extend almost up to the neural shields. The axillary buttress has a connection with the first rib. Entoplastron lies anterior to the humero-pectoral suture. Skull is with a bony temporal arch. The qaudrato-jugal articulates with the post-orbital and jugal. Jaws have markedly broad alveolar surfaces and that of the upper jaw is with a prominent median ridge. Bony choanae are on a level with the middle or hinder portion of the orbit. Fourth vertebral shield is much longer than broad, longer than third; overlapping four of five neural bones. Skin of the posterior upper part of head is divided into many shields. Limbs are with fully webbed digits. Tail remains short throughout life. At present seven species of this genus inhabit Indian Region. Fossits have been recovered from the Pleistocene deposits of the Siwalik Hills and Narbada Valley.

Key to the species

A. Broad suture is formed between the third and fourth vertebral shields. The fourth vertebral shield overlaps 4 neural bones which are always longer then broad.
   1. Second vertebral shield is pointed and overlaps the third vertebral; humero-pectoral suture of plastron is straight ..... *K. dhongoka*
   2. Second vertebral shield with a straight transverse posterior margin; humeropectoral suture is curved or forming an obtuse angle.

      Alveolar surface of upper jaw is very broad, the median ridge almost near mid-way between the outer and inner margin; choanae behind the level of the eyes ..... *K. kachuga*

      Alveolar surface of upper jaw is broad, the median ridge is nearer the inner than the outer margin; choanae on a level with the middle of the eyes ..... *K. trivittata*

B. Fourth vertebral shield is pointed anteriorly, having a slight contact with the third vertebral and overlap five neural bones.
   1. 24 marginal shields are present; posterior margin of carapace is not or feebly serrated. Third vertebral shield elongate, quadrangular or pen-

tagonal (in young) and with almost straight posterior border. The keel of the third vertebral shield terminates in a rounded projection ..... *K. smithi*

2. Third vertebral shield is not much elongate, always pentagonal and pointed behind. The keel of the third vertebral shield terminates in a backwardly projecting spine. Second vertebral shield longer than third ..... *K. tecta*
   Second vertebral shield shorter than third ..... *K. tentoria*
3. 26 marginal shield are present; posterior margin of carapace is strongly serrated ..... *K. sylhetensis*

BROWN RIVER TURTLE
19. *Kachuga smithi* (Gray 1863)
(Figs. 109 &110)

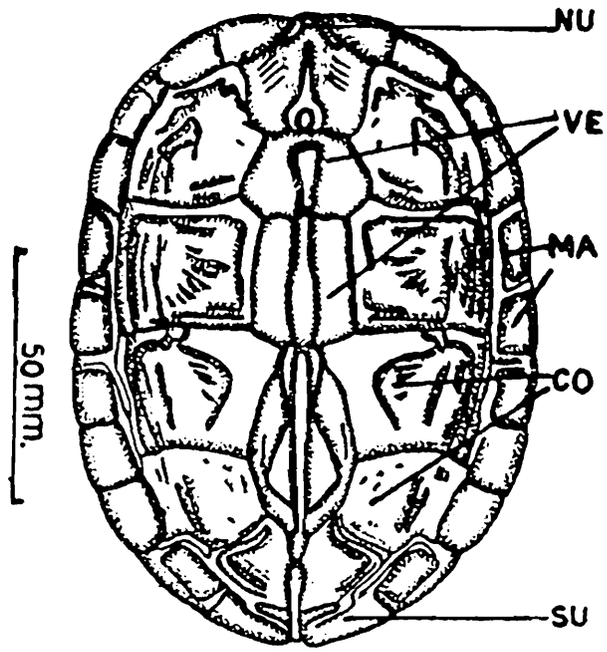
1863. *Batagur smithi* Gray, *Proc. Zool. Soc.* 253 (type loc. Chenab River, Punjab; Brit. Mus.)

1890. *Kachuga smithi*, Boulenger, *Fauna Brit. Ind.* 42.

1907. *Kachuga sylhetensis* Annandale, *Rec. Ind. Mus.* 1: 171.

This is a small turtle and reaches maximum length of 23 cm. The head is moderately small, snout is pointed, shorter than the orbit and projecting much beyond the lower jaw. Skin of the posterior portion of head is divided into shields. Skull is with a bony temporal arch. The quadrato-jug al is in contact with the jugal and the post-orbital. Alveolar surface of jaws is very broad, that of the upper jaw with a prominent median ridge, which is nearer to the inner than the outer margin. Upper jaw is not notched at the middle. The carapace (Fig. 109) is depressed, with obtuse, interrupted, vertebral keel; its posterior margin may be regular or in certain cases feebly serrated. Nuchal shield is not very large, broadest at the posterior aspect. First vertebral shield is longer than broad in the adult; second shortest, broader than long and almost with a straight posterior aspect, third longer than broad, pentagonal in the yound but subquadrangular in the adult, its posterior border is almost straight; fourth vertebral longest, with a narrow, pointed anterior margin forming a narrow sutural articulation with the third vertebral; firth vertebral distinctly broader than long and much broader than other vertebral shields. The plastron (Fig. 110) consists of paired gular, humeral, axillary, pectoral, abdominal, inguinal, femoral and anal shields. It is almost equal in length to the carapace, strongly angulate laterally in juveniles, truncate anteriorly; hind lobe of the plastron narrower than the shell-opening, notched posteriorly, shorter than the width of the plastral bridge. The longest median suture is between the abdominal shields, the shortest between the gular; inguinal shields large, axillary shield is smallest. Limibs are with fully and broadly webbed digits and have transversely enlarged scales. Fore limbs are provided with five claws. Tail remains quite short throughout life and exhibits no difference between juveniles and adults. General dorsal colouration is pale olive. Vertebral keel is blackish. Ventrum is yelloew and each plastral shild is provided with a dark brown tinge. In many individuals the shields of plastron are completely black with narrow white borders. Top of head is black. Prominent reddish or pink spots are present behind the eyes. Neck has got light brown longitudinal stripes.

Distribution : India : Ganga river system, Elsewhere : Pakistan : Sind river system. Records are also available from the Bangladesh.



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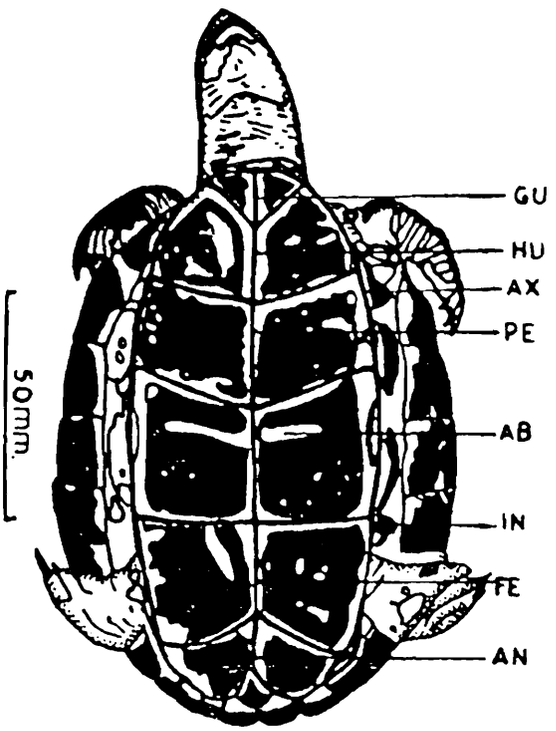

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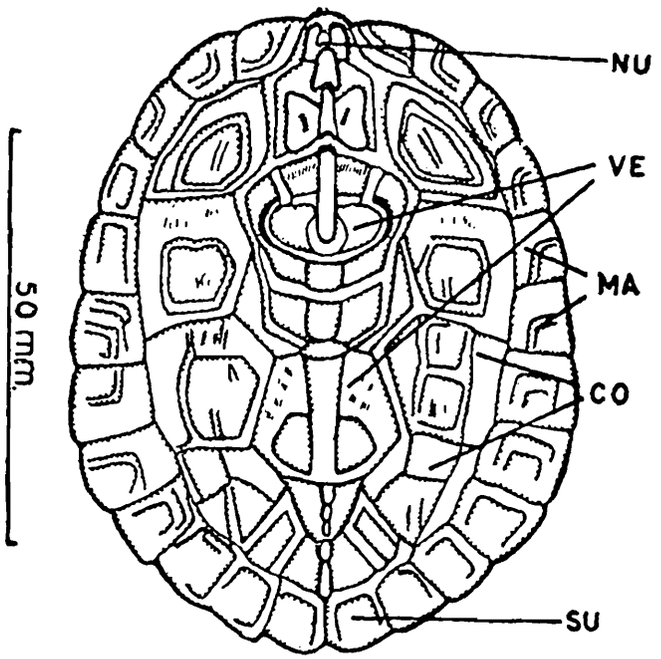

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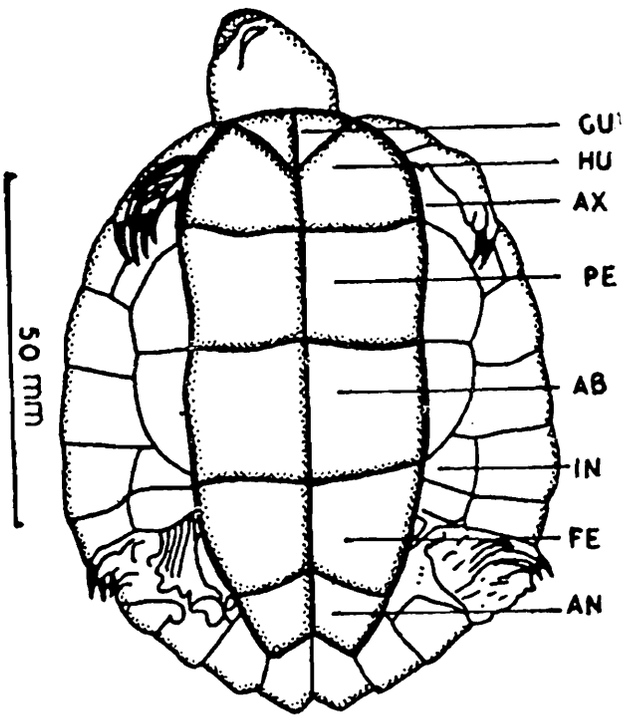

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Figs. 109 & 110. *Kachuga smithi* (Gray). 109. Carapaci; 110. Plastron.

Figs. 111 & 112. *Kachuga dhongoka* (Gray). 111. Carapace; 112. Plastron.

Habits and habitat : The species is entirely aquatic and is a rapid swimmer. It is omnivorous and devours flesh readily. Lays five to eight eggs on the sandy banks of river in a single clutch; eggs measure 33 mm. in length and 24 mm. in width.

Status : The species is vulnerable. Population is considerably reduced in recent years owing to mass exploitation for food and habitat destruction.

DHONGOKA TURTLE

20. ***Kachuga dhongoka*** (Gray 1834)
(Figs. 111 &112)

1834. *Emys dhongoka* Gray, *Illus. Ind. Zool.* 2 : pl.60 (type loc. N. India).

1879. *Batagur duracelli* Anderson, *Zool. Res. w. Yunnan*, 738.

1931. *Kachuga dhongoka* Smith, *Fauna Brit. Ind.* 1 : 130-131.

This is a moderately large turtle, whose females are larger and reach a maximum length of 40 cm. Males never exceed 20 cm. in length. The head is moderately long with a pointed snout which projects beyond the lower jaw and is shorter than the orbit. Skin of the posterior portion of head is divided into shields. Skull is with a bony temporal arch. The quadrato-jugal being in contact with the jugal and the post-orbital. Alveolar surfaces of jaws very broad, that of the upper jaw with a strong median ridge which is nearer to the inner than to the outer margin; bony choanae are on a level with the middle part of the orbits. Upper jaw is feebly bicuspid. The carapace (Fig. 111) is smoth, depressed, unicarinate, the keep interrupted, most prominent upon the second and third vertebral shields, where it terminates in a pointed knob in the young and becomes less marked with advancing age; posterior margi feebly crenulated. Nuchal shield is not very large and broadest at the posterior aspect. First vertebral is longer than broad, more or less constricted in the middle; second broader than long in the yound, longer than broad in the adult, narrowing posteriorly, its posterior margin is produced and fitting into an emargination of the third shield, which is shorter than the second or fourth; third vertebral shield forming a broad suture with the fourth, which overlies parts of four or five neural bones; neural plates much longer than broad. The plastron (Fig. 112) consists of paired gular, humeral, axillarty, pectoral, abdominal, inguinal, femoral and anal shields. It is long and narrower than the opening of the shell, angulate laterally in the yound, truncate anteriorly, notched posteriorly; the width of the bridge considerably exceeds the length of the posterior lobe. The longest median suture is between the abdominal shields, the shortest between the gular; humero- pectoral suture straight; inguinal shield large, axillary smaller. Limbs are with fully and broadly webbed digits and have transversely enlarged scales. Fore limbs are provided with five claws. Tail remains quite short throughout the life and exhibits no difference between juveniles and adults. General dorsal colouration is oblivaceous or brownish with black vertebral stripe. In yound individuals two black lateral stripes are present. Ventrum is yellowish. All the shields of plastron are generally having a large reddish-brown patch in the juveniles. Soft parts are olivaceous or yellowish, a yellow stripe runs along the side of the head starting from the nostrils and passing above the eye and tympanum.

Distribution : India : Eastern Ganga river system as far west as Allahabad. The

species has also been recorded from the Brahmaputra. Elsewhere : Nepal. Fossils have been found in the Siwalik hills.

Habits and habitat : The species is entirely aquatic and lives on vegetable matter. About 30 to 35 elongate eggs measuring 55x33 mm. are deposited on the sandy banks in a single clutch.

Status : The species is extremely vulnerable. The main threats of the species are over-exploitation of adults and their eggs by animal predators and man for food and habitat destruction. The flesh of the species is much esteemed as food.

Conservation : Generally protected by legislation throughout its range but the conservation measures are not effective.

BENGAL ROOFED TURTLE

21. ***Kachuga kachuga*** (Gray 1831)

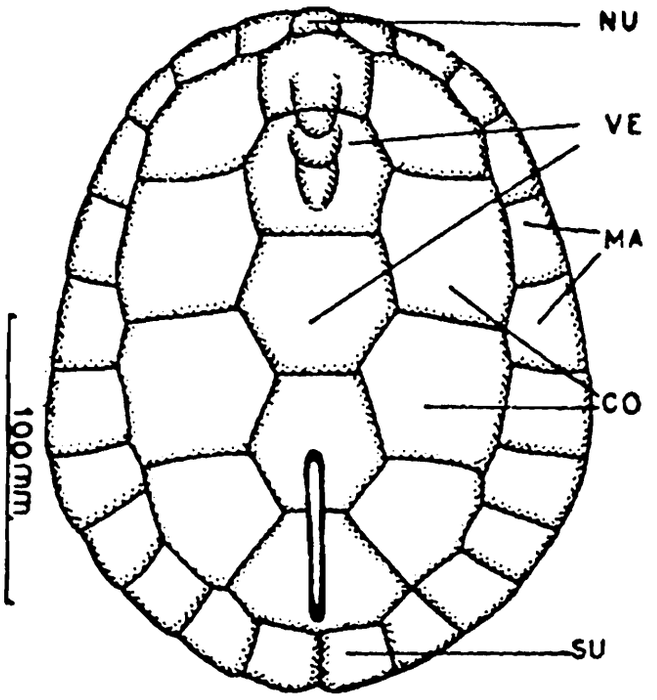
(Figs. 113 &114)

1831. *Emys kachuga* Gray, *Illus. Ind. Zool.* pt. 5, pl.9 & 74 (type loc. N. India).

1831. *Emys dentata* Gray, (in part), *Syn. Rept.* 20 and errata (correction of dhor) pls. 8-9.

1831. *Emys lineata* Gray, *Syn. Rept.* 23 (based on two unpublished drawings of Hardwicke's Nos. 5 & 6 in *Brit. Mus.*; type loc. India).

This is a moderately large turtle in which also females are larger than males and reach a maximum length up to 39 cm. The head is moderately long snuot is pointed, slightly upturned, shorter than the orbit and projecting much beyond the lower jaw. Skin of the posterior portion of head is divided into shields. Skull is with a bony temporal arch. The quadrto-jugal is in contact with the jugal and the poster-orbital. Alveolar surfaces of jaws very broad, that of the upper jaw with a strong and prominent median ridge which is medially situated between the inner and the outer margins. Bony choanae on a level with the posterior portion of the orbits. Upper jaw is feebly bicuspid in the adult individuals. The carapace (Fig. 113) is depressed unicarinate, the keel is interrupted and reminas most prominent upon the second and third vertebral shields, where it terminates in a pointed knob-like structure in the juveniles but disappears gradually in the adult individuals. Posterior margin of the carapace is crenulated in the yound. Nuchal shield is not very large, broadest at the posterior aspect. First vertebral shield as long as broad; second vertebral shield broader than long in the yound, about as broad as long in the adult, longer than the third vertebral, with which it forms a straight transverse suture; fourth vertebral is longest and forms a broad sutural margin with the third vertebral. The plastron (Fig. 114) consists of paired gular, humeral, axillary, pectoral, abdominal, inguinal, femoral and anal shields. It is long and narrow, considerably narrower than the opening of the shell, angulate laterally in the yound, truncate anteriorly, openly emarginate or notched posteriorly; the width of the platral bridge exceeds the length of the hind lobe of plastron. The longest median platral suture is between the abdominal shields, the shortest between the gular; humero-pectoral suture curved or forming an obtuse angle; inguinal shield large, axillary smallest. Limbs are with fully and broadly webbed digits and have narrow, transversely enlarged scales. Forelimbs are provided with five claws. Tail remains quite short throughout life and exhibits no difference



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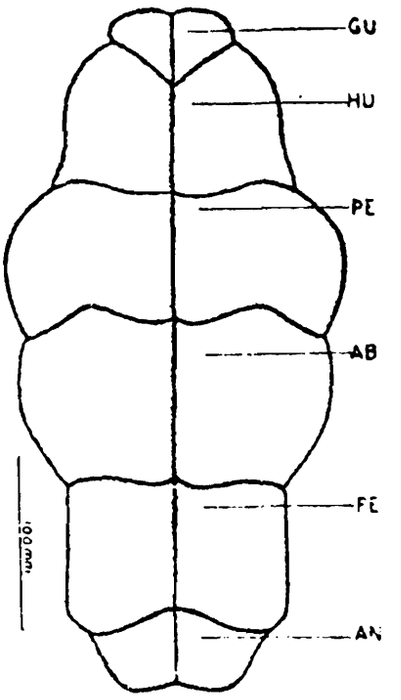

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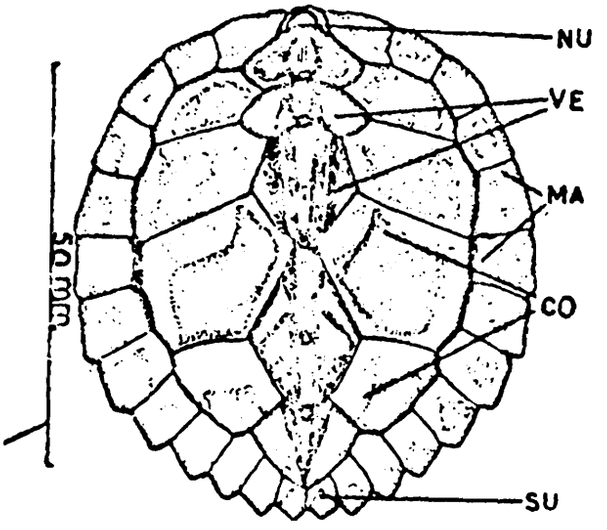

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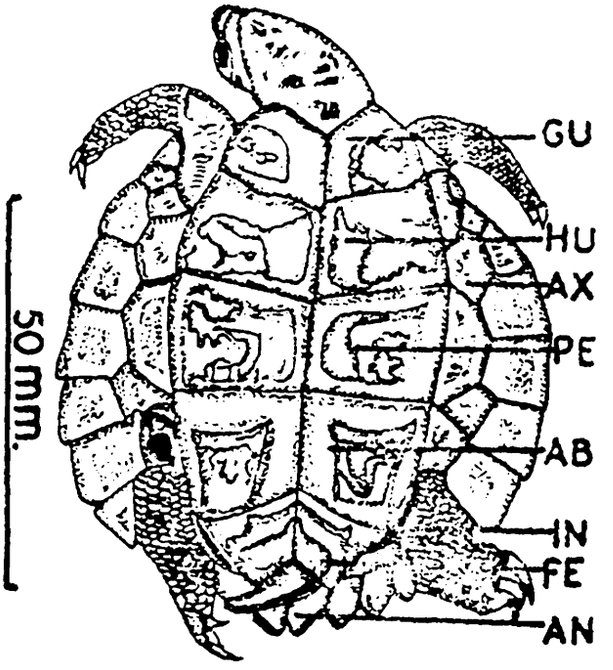


116

Figs. 113 & 114. *Kachuga hachuga* (Gray). 113. Carapace; 114. Plastron.
Figs. 115 & 116. *Kachuga sylhetensis* (Jardon). 115. Carapace; 116. Plastron.

between juveniles and adults. General dorsal colouration is olivaceolus or brownish. Ventrum is yellowish. Neck is light brown, with seven reddish longitudianl stripes. Lateral aspects of head bluish; throat with a pair of oblong red or yellow markings. Top of head in male has a brilliant red colour during the breeding season.

Distribution : India : Ganga river system of Bengal, Bihar and Uttar Pradesh. Elsewhere : Bangladesh and Nepal.

Habits and habitat : The species is entirely aquatic and inhabits freshwater bodies and plenty of aquatic vegetarian. It is mainly herbivorous. Eggs are laid on the sandy banks of Ganga during March.

Status : The species is extremely vulnerable. The population is towards decline in recent years on account of large scale exploitation for food and on account of habitat destruction and abrupt changes in ecology caused by and construction of various dams and reservoirs in the area. These turtles used to be common 20 years ago but on account of excessive killing by man in the recent past, the numbers now have been reduced considerably. Though exact figures are not known, illegal trade exists all over its range. Nesting areas on the banks of the Ganga and other rivers are destroyed by the removal of earth for commercial purposes. This causes a sudden loss of aquatic and other vegetation on the banks, thus creating scarcity of food for turtles, and gradually their population declinesd on account of starvation. On account of various Hydroelectric and other projects like dams, many portions of the river systems in the range of species remain dry for a considerable period in the year and cause a sudden and radical change in the ecology of these water loving creatures and ultimately force them to die.

Conservation : Generally protected by legislation throughout its range but the conservation measures are not adequate.

ASSAM SAW-BACK TURTLE

22. ***Kachuga sylhetensis*** (Jerdon 1870)

(Figs. 115 &116)

1870. *Pangshura sylhetensis* Jerdon, *Proc. Asiat. Soc.* Bengal, 69 (type loc. Khasi Hills, Assam; Brit. Mus.).

1890. *Kachuga sylhetensis*, Boulenger, *Fauna Brit. Ind.* 42.

1931. *Kachuga sylhetensis,* Smith, *Fauna Brith. Ind.* **1** : 129.

This is a small and rare species which hardly reaches to a length of 18 cm. The head is moderately small, snout pointed, shorter than the orbit and projecting much beyond the lower jaw. Skin of the posterior portion of head is feebly divided. Skull is with a bony temporal arch. The quadrato-jugal is in contact with the jugal and the post-orbital. Alveolar surfaces of jaws very broad, that of the upper jaw with a strong and prominent median ridge. Upper jaw is hooked. The carapace (Fig. 115) is elevated, with a prominent vertebral keel which is abruptly transformed into a tough backwardly projecting spike at the posterior margin of the third vertebral shield. Posterior margin of the carapace is very strongly serrated. Nuchal shield is not very large; first vertebral shield is broader in front than behind in the juveniles but the width is constant all over the length in the adults. Second vertebral shield is broader than long with an almost straight posterior border and is shortest among all the vertebral

shields. Third vertebral shield is distinctly longer than broad, obtusely pointed posteriorly and its tip touching the sharp anterior tip of the fourth vertebral shield. Fourth vertebral shield has the longest anterior extremity among the vertebral shields. Fifth vertebral shield is longer than broad and is absolutely pointed at the posterior margin. Marginal shields are 26 in number (including the paired supracaudals). The plastron (Fig. 116) consists of paired gular, humeral, axillary, pectoral, abdominal, inguinal, femoral and anal shields. It is long as the carapace, angulate laterally, truncate anteriorly; hind plastral lobe is smaller than the shell opening, notched posteriorly, its length slightly less than the width of the bridge; the longest median suture is between the abdominal shields, the shortest between the gular; axillary and inguinal shields are comparatively large. Limbs are with fully and broadly webbed digits and have transversely enlarged scales. Tail remains quite short throughout the life and exhibits no difference between juveniles and adults. General dorsal colouration is olivaceous or brownish Vertebral keel is paler. Ventrum is yellow. Each plastral shield is with a large dark brown spot. Head and limbs brownish. There is a yellow wavy transverse stripe across the back of the head and another along the lower jaw. Neck has many light yellow longitudinal streaks.

Distribution : India : Garo, Khasi and Naga Hills.

Habits and habitat : The species is fully aquatic and inhabits stagnat and slow running waters in the hilly terrain with plenty of aquatic vegetation. It is mainly herbivorous. Not much is known about its breeding habits except that the species lays elongated somewhat oval eggs.

NORTH INDIAN ROOFED TURTLE
23. *Kachuga tecta* (Gray 1831)
(Figs. 117 & 118)

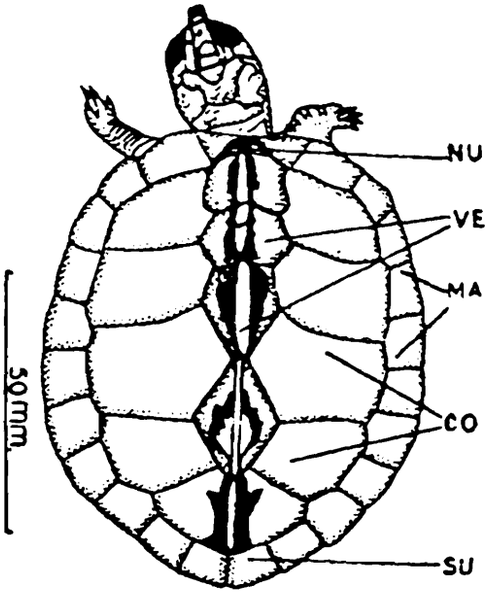
1831. *Emys tectum (tecta)* Gray, *Syn. Rept.* 23, pl. 5 (type loc. India).

1831. *Emys trigibbosa*, Lesson, *Bull Sc. Nat.* 25 : 120.

1890. *Kachuga tectum*, Boulenger, *Fauna Brit. Ind.* : 43.

1931. *Kachuga tecta* Smith, *Fauna Brit. Ind.* 1 : 126-128.

This is a small species and the females never reach more than 23 cm. in length, males are still smaller. The head is moderately small, pointed, shorter than the orbit. Skin of the posterior part of head is divided into large shields. Skull is with a bony temporal arch. The quadrato-jugal is in contact with the jugal and the post-orbital. Alveolar surfaces of jaws quite broad, that of upper jaw with a prominent median ridge which is nearer to the inner than the outer margin. Upper jaw is not noteched. The carapace (Fig. 117) is elevated and rounded in adult individuals. Vertebral keel is prominent, abruptly transforms into a strong spinous process at the posterior margin of the third shield. Posteror margin of the carapace is generally not much serrated. Nuchal shield is usually broadest at the posterior margin; first vertebral shield is variable in shape, with straight lateral margins in juveniles, the anterior portion of this shield becomes narrower in the adults; second vertebral shield is generally longer than the third, and obtusely pointed posteriorly; third vertebral is pointed behind and touches the pointed extremity of the fourth vertebral; fourth vertebral shield is much longer than the other vertebral shields; fifth vertebral shield is broader than long



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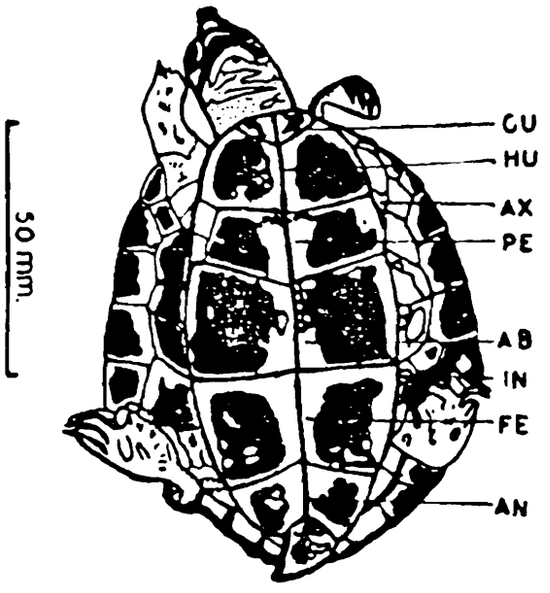


118

Figs.117&118 *Kachuga tecta* (Gray). 117. Carapace; 118. Plastron.

and is much broader than other vertebrals. The plastron (Fig. 118) consists of paired gular, humeral, axillary, pectoral, abdominal, inguinal, femoral and anal shields. Plastron is almost as long as the carapace, angulate laterally, truncate anteriorly; hind plastral lobe is smaller than the shell opening, notched posteriorly, its length is slightly less or almost equal to the width of the plastral bridge; the longest median suture is between the abdominal shields, the shortest betwee the gular or the anal; axillary and inguinal shields are almost equal. Limbs are with fully and broadly webbed digits and have transversely enlarged scales. Tail remains quite short throughout life and exhibits no difference between juveniles and adults. General dorsal colouration is olivaceous with minute black spots and orange or reddish vertebral stripe. The vertebral stripe is most distinct on the anterior dorsum extending up to first three shields. In the adults colouration becomes dark olive-brown and the spots become inconspicuous. The rim of the shell remains pinkish-yellow throughout the life. Ventrum is reddish, yellowish or reddish-yellow with large dark brown or almost black spots. Head is blackish, temporal region orange or yellow, neck is blackish with thin yellow longitudinal lines, limbs dark olive with yellow spots, back of thigs with dark trasverse streaks.

Distribution : India : Ganga and Brahmatputra river systems. Elsewhere : Pakistan : Sind river system. Fossils have been recorded from the Pleistocene deposits of the Siwalik Hills.

Habits and habitat : The species is fully aquatic and inhabits freshwater bodies with plenty of aquatic vegetation. It is a less active species and comparatively a poor swimmer. It feeds chiefly on vegetable matter. Not much is known about its breeding habits. Eggs are round or oval in the same clutch.

Status : This most familiar species has become extremely vulnerable and its population has been reduced enourmously due to over exploitation (eggs as well as

adults) for food. Habitat destruction is also a most important threat. The nesting areas of the species are destroyed by removing the sand for commercial purpose and as such aquatic vegetation is lost. This factor create the scarcity of food for these turtles and the population declines automatically. The construction of various Hydroelectric projects also has a bearing on the habitat destruction of these turtles.

Conservation : Nominally protected by legislation. The detailed ecological investigation of this species with help in ascertaining the approximate numbers, distribution pattern and ecological preference with a view to design suitable conservation and management plans.

SOUTH INDIAN ROOFED TURTLES

24. *Kachuga tentoria tentoria* (Gray 1834)

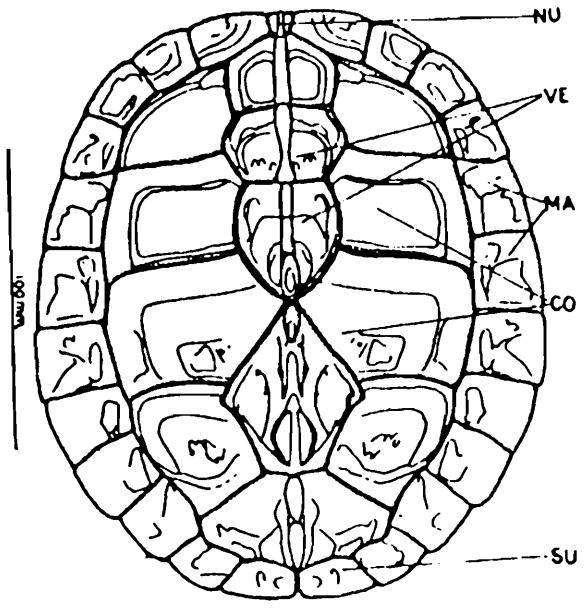
(Figs. 119 &120)

1834. *Emys tentoria* Gray, *Proc. zoo. Soc.* Lond. 54 (type loc. Dhond, Poona Dist., Brit. Mus.)

1890. *Kachuga intermedia* Boulenger, *Fauna Brit. Ind.* 43.

1931. *Kachuga tentoria tentoria* Smith, *Fauna Brit. Ind.* 1 : 128.

This is a small species in which the adult female is similar to *Kachuga tecta* in size and maximum length never reaches beyond 19 cm. The head is moderately small and pointed shorter than the orbit and feebly projecting beyond the lower jaw. Skin



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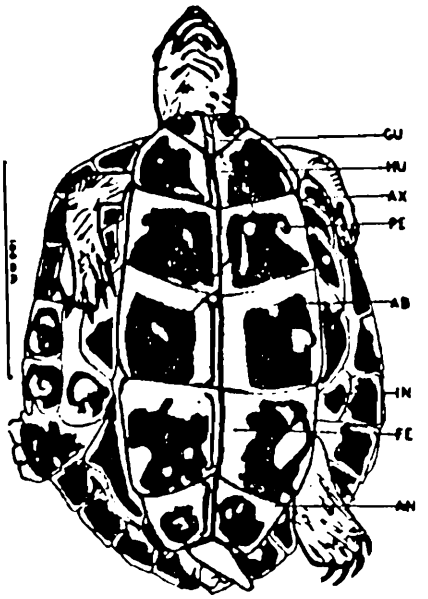


120

Figs. 119&120. *Kachuga tentoria tentoria* (Gray).

of the posterior part of the head is divided into large shields. Skull is with bony temporal arch. The quadrato-jugal is in contact with the jugal and the post-orbital. Alveolar surface of jaws quite broad, that of upper jaw with a prominent median ridge which is nearer to the inner than the outer margin. Upper jaw is not notched. The carapace (Fig. 119) is elevated and rounded in adults. Vertebral keel is prominent and abruptly forms a strong spinous process at the posterior margin of the third shield. Posterior margin of the carapace is generally not serrated. Nuchal shield is usually broadest at the posterior margin; first vertebral shield is much variable in shape, with straight lateral margins in juveniles, anterior part of the shield becomes narrower in adults; second vertebral shield is most variable, generally shorter than the third, obtusely pointed posteriorly; third vertebral is pointed behind and touches the sharp pointed extremely of the fourth vertebral, fourth vertebral shield is much longer than the other vertebral shields; fifth vertebral shield is broader than long and is much other vertebral shields; fifth vertebral shield is broader than long and is much broader than other vertebrals. The plastron (Fig. 120) consists of paired gular, humeral, axillary, pectoral, abdominal, inguinal, femoral and anal shields. Plastron is almost as long as the carapace, angulate laterally, truncate anteriorly; hind plastral lobe is smaller than the shell opening, notched posteriorly, its length is slightly less or almost equal to the width of the plastral bridge; the longest median suture is between the abdominal shields, the shortest between the gular or the anal; axillary and inguinal shields are semiequal. Limbs are with fully and broadly webbed digits and have transversely enlarged scales. Tail remains quite short throughout the life and shows no difference between juveniles and adults. General dorsal colouration is pale olivaceous. Yellow streaks on neck are absent or indistinct. The head is dull olive and devoid of coloured spots on the temporal region; there is a distinct red marking behind the tympanum; limbs are devoid of spots and the dark bars at the back of the thigs are numerous.

Distribution : India : Mahanadi, Godavari and Krishna river systems.

Habits and habitat : The species is absolutely aquatic and inhabits the slow running water near the banks and still water pools on the river side. It is an active swimmer and is mainly herbivorous. Nothing is known about its breeding habits.

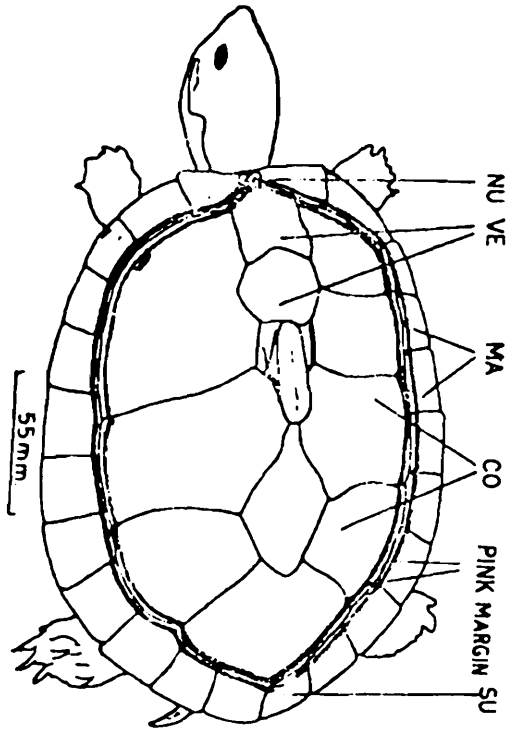
Status : Species has become vulnerable on account of large scale habitat destruction. Its flesh is not considered suitable for consumption.

Conservation : Nominally protected by legislation.

24a. ***Kachuga tentoria circumdata*** Mertens 1969
(Figs. 121 & 122)

1969. *Kachuga tentoria circumdata* Mertens, Eine neue Rasse der Dachschidkrote, *Kachuga tecta, Senckenbergiana biol.* 50 (1/2) : 23-30.

The taxonomic characters of this small subspecies reaching up to length of 23 cm. are like the nominate form i.e. *Kachuga tentoria tentoria* from which it differs in general colouration and in having a pink ring along the peripheral marginal junction (Fig 121). The carapace is olive-brown in colour; dorsal keel is deep red. Plastron (Fig 122) is yellow, with only one black spot on each plastral shield. The middle of fore head is



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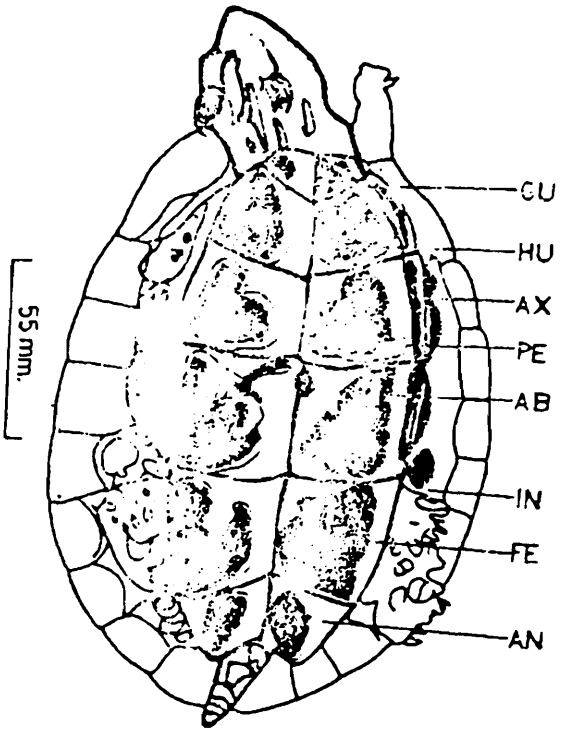

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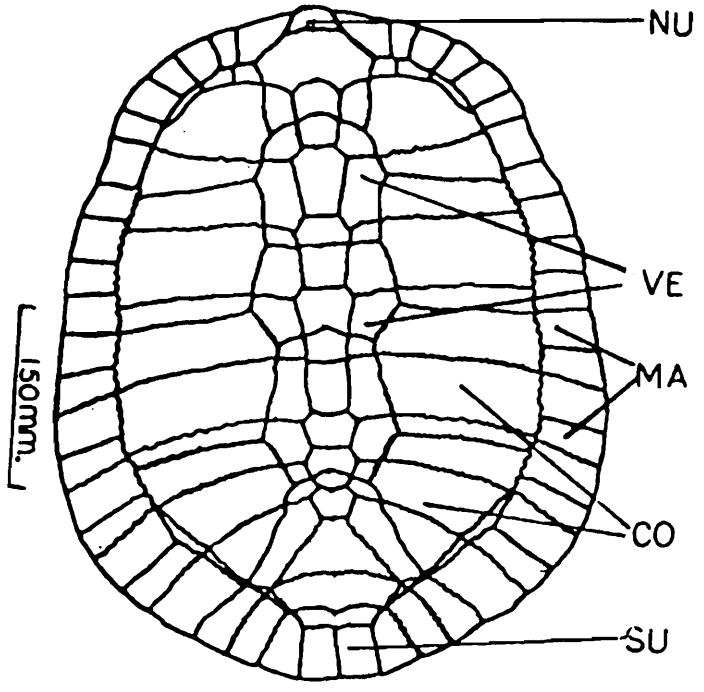

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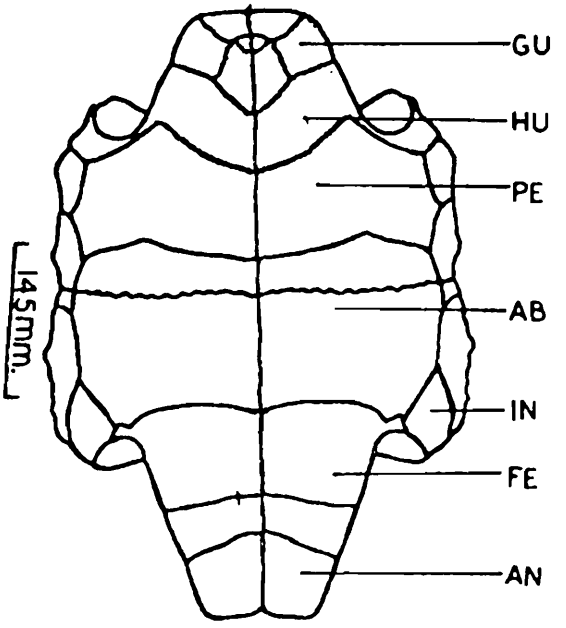


124

Figs. 121 & 122. *Kachuga tentoria circumdata* Mertens. 121. Carapace; 122. Plastron.
Figs. 123 & 124. *Kachuga trivittata* (Dum. & Bibr.). 123. Carapace; 124. Plastron.

having two curved bands; back side of the eye is spotted with pink; neck is with few indistinct stripes; limbs are devoid of spots or markings.

Distribution : India : Madhya Pradesh, Rajasthan and Uttar Pradesh (Ganga river system of western India).

Habits and habitat : The species is absolutely aquatic and inhabits the slow running water near the banks and still water bodies on the river side. The turtle is an active swimmer and survives mainly on aquatic vegetation. It nesting season is from late October to late December and nests are dug on the sandy river banks and sometimes in clusters of dead leaf litters and under the cover of vegetation. From 5 to 7 eggs are despatched.

Status : Species has become vulnerable on account of large scale habitat destruction.

25. *Kachuga trivittata* (Dumeril & Bibron 1835)
(Figs. 123 &124)

1835. *Emys trivittata* Dumeril & Bibron, Erp. Gen. 2 : 331 (type loc. Bengal; Paris Mus. Nat. Hist.).

1879. *Batagur iravadica* Anderson, *Zool. Res.* w *Yunnan*, 736, pls. 64, 65 & 73 B, figs. 16-20 (type loc. Pegu and Bhamo, Burma).

1931. *Kachuga trivittata*, Smith, *Fauna Brit. Ind.* 1: 132- 133.

This is the largest species of the genus *Kachuga* where the length of the shell reaches 460 mm. in males and 580 mm. in females. The taxonomic characters of this Burmese turtle is quite similar to its Indian counterpart *Kachuga kachuga* from which it difers by having, alveolar surfaces of jaws broad; upper jaw is with a prominent median ridge, which is nearer to the inner than the outer margin; bony choanae on a level with the middle of the oribts. The carapace of the male is pale olve-green with three prominent longitudinal stripes which generally unite at their ends. The carapace and general dorsum of female is dark- brown. The plastron of the male is pale orange-yellow but of the female is dark brownish. The head and neck olivaceous; a large black lozenge-shaped patch is on the head (sometimes only a streak is available). Limbs are yellowish.

Distribution : Burma (Found in Irrawaddy and Salween river systems). The species is said to be available in the Irrawaddy as far north as Bhamo.

Habits and habitat : The species is absolutely aquatic and is an accomplished swimmer. Breeding season extends through December and January, when 25 eggs (70-75 x 40-42 mm.) are deposited in sand-banks above tidal limits.

Status : Species has become vulnerable on account of large scale habitat destruction as a result of urbanisation.

Genus 16. *Batagur* Gray 1855

1855. *Batagur* Gray (in part), *Cat. Sh. Rept.* 1 : 35.

1890. *Batagur*, Boulenger, *Fauna Brit. Ind.* 38.

1931. *Batagur*, Smith, *Fauna Brit. Ind.* 1: 134.

The main generic characters are : Vertebral shields are short- sided anteriorly;

axillary and inguinal buttresses are well developed and extend almost up to vertebral shields; plastron is united to the carapace by a suture; the axillary buttresses is connected with the first rib; entoplastron is anterior to the humeropectoral suture. Skull with a bony temporal arch; the quadrato-jugal is in contact with the jugal and post-orbita; bony choanae is on a level with the posterior part of the orbits; alveolar surfaces of jaws are very broad, with two strong denticulated ridges; fourth vertebral shield is small as long as broad, smaller than third vertebral shield; digits are fully webbed; with four claws only; tail very short, not longer in the yound than in the adult. The genus is monotypic.

BATAGUR RIVER TERRAPIN

26. *Batagur baska* (Gray 1831)

(Figs. 125 &126)

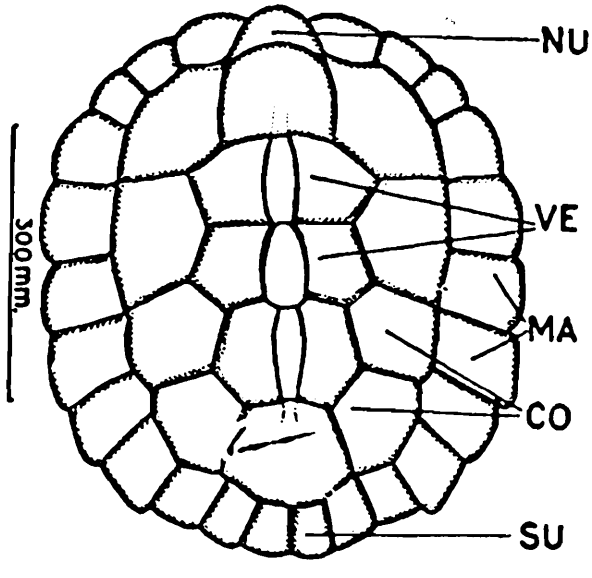
1831. *Emys baska* Gray, *Syn. Rept.* 24 (type loc. India).

1834. *Emys tetraonyx* Schlegel, *Fauna Japan.* 43 (substitute name for *Trionyx longicollis*).

1890. *Batagur baska* Boulenger, *Fauna Brit. Ind.* 38.

1931. *Batagur baska*, Smith, *Fauna Brit. Ind.* 1 : 134-137.

The Batagur is a moderately large, web-footed, aquatic species of terrapin, reaching a length of 61 cm. Adults weigh up to 18 kg. when fully mature. The head is comparatively small with an upturned, pointed and strongly projecting snout. The skin of the posterior portion of head is divided into small shields. The skull is characterised by having a bony temporal arch, quadrato- jugal is in contact with the juga and post-orbital, bony choanae on level with the posterior part of the orbits, alveolar surface of jaws very broad with two strong, denticulate ridges placed in the middle of both the upper and lower jaws. Upper jaw is provided with a notch at the middle. The carapace (Fig 125) is smooth, shining, subtruncated anteriorly, rounded posteriorly,



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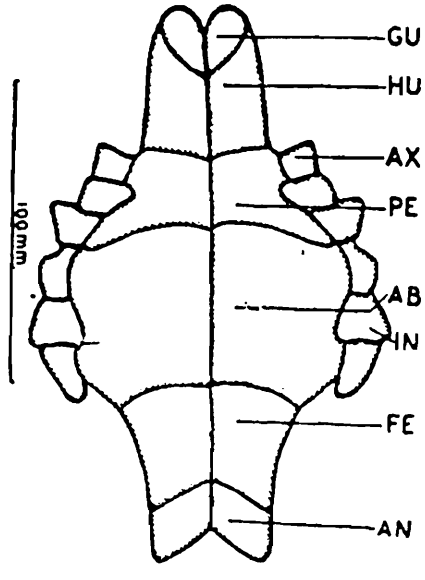

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Figs. 125 & 126. *Batagur baska* (Gray). 125. Carapace; 126. Plastron.

heavy and moderately depressed. In the yound an interrupted keel is present, which reduces gradually as growth takes place and ultimately disappears in the fully mature adult. The nuchal shield is subquadrangular, quite broader than long in posterior aspect. Vertebral shields are 5 in number, the second and the third are subequal, fourth is smaller. Vertebrals are much broader than long in young individuals but in adult they are almost as broad as long and a little narrower than the costal shields in adults. Costal shields are 4 on each side. Marginal shields are generally 25, rarely 26 (including one nuchal and a pair of supracaudal shields). The plastron consiss of paired gular, humeral, axillary, pectoral, abdominal, inguinal, femoral and anal shields. The plastron (Fig. 126) is much smaller than the sehll opening, laterally angulated in the yound and rounded in the adult, truncated anteriorly and notched posteriorly. The inguinal shield of the plastron is larger than the axillary. The width of the bridge of plastron is more than the length of the hind lobe; the longest median suture is between the abdominal shields and the shortest between the gular shields. Limbs are with narrow transversely enlarged scales, digits fully webbed and are provided with four claws. Tail is extremely short in comparsion with the body. Its shell is uniformly brown, olive brown or greenish; the head and the under surface of the neck are brown. In the breeding season, the male assumes a brilliant colouration, the nostrils becoming pale blue, iris from yellow-cream to white; the head deep black, and the neck and the front limbs deep crimson to black. The hind part of the Batagur remains dull reddish purple and eye greenish yellow throughout its life.

Distribution : India : West Bengal (Sundarbans). Elsewhere : Sumatra, west Malaysia, Thailand, Bangladesh, Burma. Kampuchia, and Vietnam. Prehistoric remains of this turtle indicate that it was widely distributed in the Ganga river system up to twelfth century A.D. Fragments of this species have also been recorded from the Mohanjodaro and Harappa sites.

Habits and habitat : The Batagur is found in fresh, brackish and even salt waters. It occurs in freshwater lakes, canals or other water bodies. But its most favourite habitat is the shallow, muddy, tidal regions at the wide river mouths, lined with mangrove or other vegetation. It has been observed that many individual at Trengganu (Malaysia) come above most tidial influence. At this place the river is quite shallow with sandy gravel bottom, less than 450 feet wide and banks are sandy with sparse or no vegetation. It is an omnivorous terrapin but generally prefers a vegetarian diet consisting of stems, leaves and fruits of riverside plants. It also feeds on molluses, crustaceans and fish. Mating takes place between September and November. During this period the males assume brilliant breeding colours as stated above. The Batagur prefers to nest in a colony on large sandy banks with slopes and also on river islands. Large number of females sometimes upto 500 individuals or more, emerge every year on the sandy river banks from January to March for nesting and egg laying. Nesting females are site-specific and observe a definite period for egg depositing every year and at that time they are extremely sensitive to any disturbance. The female digs a body pit for the nest by employing the four limbs, then a 15-30 cm. deep egg-chamber is excavated within it. About 50-60 oblong eggs (measuring up to 70 mm. in length) are deposited in the egg-chamber in three clutches (generally 10-30 eggs in each clutch). The interval of egg-laying varies from 15 to 20 days. The

incubation period under natural conditions ranges between 80 and 100 days. Then the nesting spot and its surroundings area is covered with sand by the mother terrapin and this takes a long time, almost twice as long as digging and egg laying. The process of sand compacting by the female is most interesting and is accomplished by the repeated raising and dropping of its body on the ground. This phenomenon of sand compacting by large number of terrapins on a beach creates a drumming sound, which can be heard from a considerable distance and is called as 'tungtong' (means drumming) in Malaysia. As the females return to the water they throw sand backwards over the nesting sites and sometimes also dig false nest pits to confuse the predators. Adult Batagur is predated upon by man, sharks and the saltwater crocodile *Crocodylus porosus*. Eggs and hatchlings are devoured by otters, dogs, monitor lizards, fishes and crocodiles.

Status : The species is endangered over much of its range, on account of large scale exploitation for its eggs and flesh for food. Batagur was over-exploited in Bengal in the mid-nineteenth century and its fat was much used for the manufacture of soap in Calcutta. It is occasionally sold in Bangladesh at Begerhat and Chalna Bazar, close to the Sunderbans. In Malaysia most adults for sale are caught accidentally by fishermen and are consumed by Chinese and native people. Eggs are considered as delicacy and even cost more than the marine turtle eggs. The habitat destruction is also a most important factor for the decline of this terrapin in Malaysia, Thailand and India. The various factors which are responsible for the habitat destruction of this species are mining, removal of riverside sand, clearing of riverside vegetation and exposing the banks to erosion, construction of dams and barrages, urbanisation along the banks and increase in the steamer traffic in the rivers.

Conservation : It is generally protected by legislation throughout its range. During the last 35 years many hatcheries have been established in Malaysia to incubate Batagur eggs. The hatchlings are raised and kept in separate concrete pools according to different age groups for one to seven years. Hatchings and juveniles of different age groups for one to seven years. Hatchlings and juveniles of different age groups are released in the river from time to time. It is estimated that about 10,000 hatchlings have been released in Perak river since 1969. The success of such hatching programmes cannot be fully confirmed until artificially hatched females are themselves shown to nest successfully. The species has been listed in Appendix 1 of the CITES. Further protection by law for the species and its habitat in all aspects must be provided to all the existing populations throughout the range. Conservation and proper management will help in providing a valuable protein rich food for numerous people within the range of this terrapin.

Captive breeding : Forty-eight Batagurs have been raised from eggs hatched in 1968 at Batu, Gajah, Perak, but significant results on breeding are not available as yet.

Family V. TESTUDINIDAE Gray 1825

1825. Testudinidae Gray, *Ann. Phil.* 10(2) : 210.

This family comprises the true land tortoises, whose neck is completely retractile within the solid shell. The carapace is covered with horny epidermal shields, frequent-

ly with distinct growth rings and is generally dome shaped. The marginal shields of the carapace are connected to the somewhat flat or slightly concave platron by a broad bridge. Nuchal shield of the carapace is without suitably developed constiform processes. The plastron is usually flat in females and concave in males, composed of nine bones. Ear chamber is completely blocked behind by the quadrate; termporal region not roofed over; a bony temporal arch is present. The digits are short and completely devoid of webs; with not more than two phalanges; metacarpals not or but slightly longer than broad; the hind feet are club-footed; the skin of the anterior side of the fore-limb is covered with strong horny scales. The skin on the top of the head is divided into shields. The tail is relatively short. Eggs are spherical in shape. Scent glands are absent in Testudinidae. The members of this family existed and flourished in India during the Pliocene Period in the Siwalik Hills. At present the family is widely distributed in tropical, subtropical and temperate zones or the world except Australia. This study which is on Indian Region comprises two genera *Geochelone* and *Testudo.*

Key to the Genera

1. Supernasals and nuchal scales are always available; only one trouble is present on each thigh; supra-caudal shield is undivided; prootic concealed in dorsal view; a posterior platral hinge is present; entoplastron intersected by humero-pectoral suture; four claws are availabe in forelimbs.....***Testudo***
2. Supranasals are always absent; nuchal shield may be present or absent; upto three tubercles are present on each thigh; two supra-caudal shields are present (anterior and posterior ones); prootic exposed in dorsal view; a posterior plastral hinge is not available; entoplastron is anterior to the humero-pectoral suture; five claws are available in fore-limbs .....***Geochelone***

Genus 17. ***Geochelone*** Fitzinger 1835

1835. *Geochelone* Fitzinger, *Ann. Wien Mus.* 1 : 111 (type *Testudo stellata* Schweigger)

1931. *Geochelone* Smith, *Fauna Brit. Ind.* 1 : 136.

Neural shields are hexagonal, tetragonal and octagonal with a narrow posterior margin; costal shields narrow and wider. Two supraphygals are present, the anterior one overlapping the smaller posterior one. Plastron intimately united carapace by distinct suture. Posterior lobe of plastron always rigid. Axillary and inguinal buttresses are quite short and do not completely reach up to the coastal shields. Gular shields of the plastron are paired. Alveolar surface of upper jaw generally with a prominent median ridge. Choanae on a level with the anterior half of the orbits; prootic bone usually exposed dorsally. Supranasal scales are always absent. The nuchal shield may be present or absent. Limbs are cylindrical, the hinder one clubshaped, covered with enlarged and very hard scales; each thigh is with three distinct spur like outgrowths, digits very short, not at all webbed. Tail is quite short, not longer in the yound than in the adult.

Key to the species

1. Only single supracaudal shield is present 2
2. Two supracaudal shields are present Carapace moderately convex, not flattened on the vertebral region in adult individuals; pectoral shields of plastron are widely separated from one another; carapace blackish ..... *G. emys* 5
2. Carapace moderately or strongly elongate; strongly covex; black, with yellow areole and yellow radiatig lines; entoplastron is anterior to himeropectoral suture 3

B. Carapace moderately elongate, convex but flattened on the vertebral region; Yellow, with black blotches; entoplastron intersected by humero-pectoral surture 4

3. Carapace strongly elongate; vertebral and costal shields forming most prominent humps in adult individuals; nuchal shield is not present, plastron is with dark rediating line; top of head is covered with irregular shields ..... *G. elegans*

   Carapace moderately elongate, vertebral and costal shields do not form humps; nuchal shield is not present; plastron is without dark radiating lines; top of head with a distinct frontal and a pair of prefontals ..... *G. platynota*

4. Nuchal shield is present; suture between the pectoral shields equal to or longer than that between humeral shields; top of head is with a pair of prefrontal, a large frontal (often subdivided) and with many smaller shields ..... *G. elongata*

   Nuchal shield is always absent; suture between the pectoral shields is shorter than that between the humeral shields; top of head is with a pair of prefrontal, a large frontal (which is never subdivided) and with many smaller shields ..... *G. travancorica*

   Carapace concave and strongly flattened on the vertebral region in adult individuals; pectoral shields of plastron in contact with one another; carapace light brown; the shields are generally with black margins ..... *G. impressa*

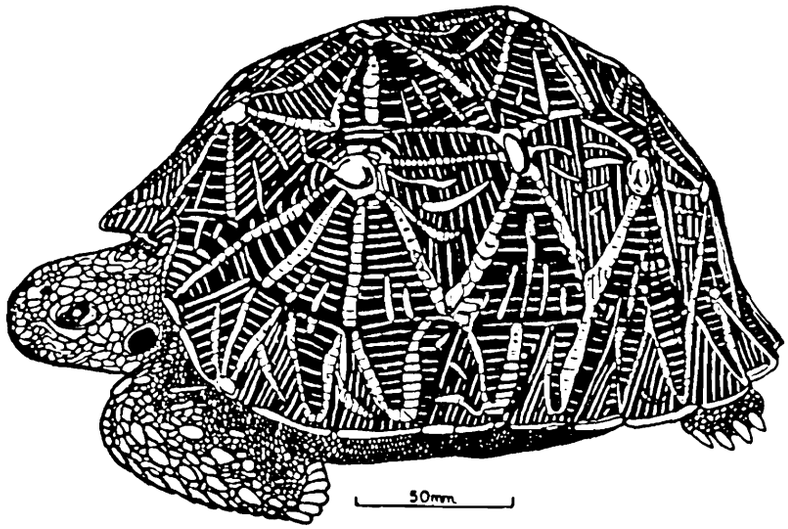
STAR TORTOISE OR INDIAN STARRED TORTOISE
27 *Geochelone elegans* (Schoepff 1792)
(Figs. 127 &128)

1792. *Testudo elegans* Schoepff, Hist. Test. 111, pl. 25 (type loc. India.)

1890. *Testudo elegans* Boulenger, *Fauna Brit. Ind.* 21, fig. 6.

1931. *Testudo elegans* Smith, Fauna Brit. Ind. 1 ; 138-140.

It is a small tortoise in which the length of largest female reaches up to 25 cm. males never exceed more than 16 cm. in length. The head is of moderate size, its anterior portion is bulged and somewhat convex. The upper jaw is slightly tricuspid. The skin at top of head is divided into small irregular shields. Carapace (Fig. 127) is elongated, highly domed, the vertebral and costal shields form well marked conical humps in the adults, the apex of each hump correspond with the areola; lateral aspects of carapace are almost vertical; anterior and posterior margins reverted, the posterior one is strongly serrated. Nuchal shield is not present. Vertebral shields are 5 in number; first vertebral is longer than broad; second to forth vertebrals are broader



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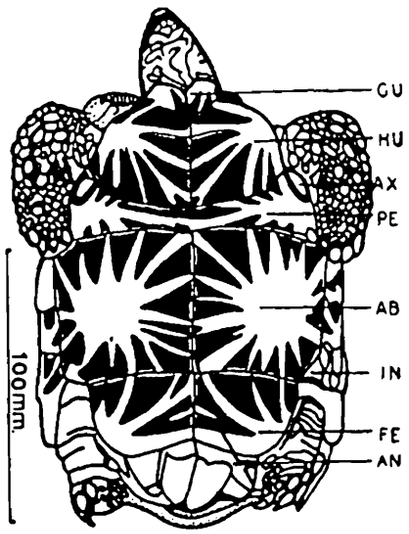

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Figs. 127 & 128 *Geochelone elagans* (Schoepff). 127. The entire lateral view; 128. Plastron.

than long. Costals are 4 in number and are equal or less broad than vertebrals. Supra-caudal shield undivided and incurved. Marginals are 22, excluding the supracaudal shield. Plastron (Fig. 128) is large, truncate or openly notched anteriorly, deeply notched posteriorly and is made up of paired gular, humeral, axillary, pectoral abdominal, inguinal, femoral and anal shields; the suture between the abdominal sheilds is largest and the shortest suture is between the pectoral or the anal shields, in the adult and fully grown individuals; axillary and inguinal shields are small. Forelimbs are with five claws; outer side of the arm of forelimb and heel are provided with large imbricate, sharply pointed, bony scales; a patch of such comparateively more larger scales are present on the back of the thigh. Tail is moderately long and terminating into a spur-like scute. Shell is black above, each vertebral and costal

shield is with a yellow areola from which radiate as many as eight streaks, ultimately producing a rediated (starred) pattern which is continuous over the marginals to the plastron. Head and limbs are yellow, more or less spotted with dark brown or black. Juveniles are almost entirely yellow or orange; with black marks along the sutures.

Distribution : India : Peninsular India and offshore islands like Karadura and Rameswaram. Elsewhere : Sri Lanka, Pakistan (Sind).

Habits and habitat : The species inhabits rocky, grassy arid areas with plenty of other vegetation. The star tortoise is quite active during the morning and evening hours of the day and feeds on grass, flowers, vegetables, fruits and all other available vegetable material. Courtship and copulation takes place throughout rainy season from June to October. About 3 to 6 hardshelled eggs are laid in a single clutch and measure from 45- 46 mm. in length and 35-37 mm. in breadth. Some of in the same clutch are almost spherical. The eggs are laid at least three times in a year and are deposited in a self-dug nest pit roughly about 15 cm. deep and 10 cm. in diameter. Before starting the digging operation, the egg laying female moistens the soil of the site by using her urine for this purpose. The mother tortoise employs her hind limbs for scraping and digging the soil. After the egg deposition is over the nest is covered with the urine-soaked muddy soil and the whole area is compacted by the female. The complete operation of egg laying is completed within four hours.

Status : Indeterminate, suspected to be threatened by habital loss.

Conservation : Listed in Appendix II of CITES which implies that commercial trade is allowed providing a permit from the country of export is obtained, this can provide a method of monitoring trade levels. The main demand of this tortise is from the Federal Republic of Germany and Switzerland. Since 1975 about 200 specimens of Star tortoises have been exported there from India and Sri Lanka.

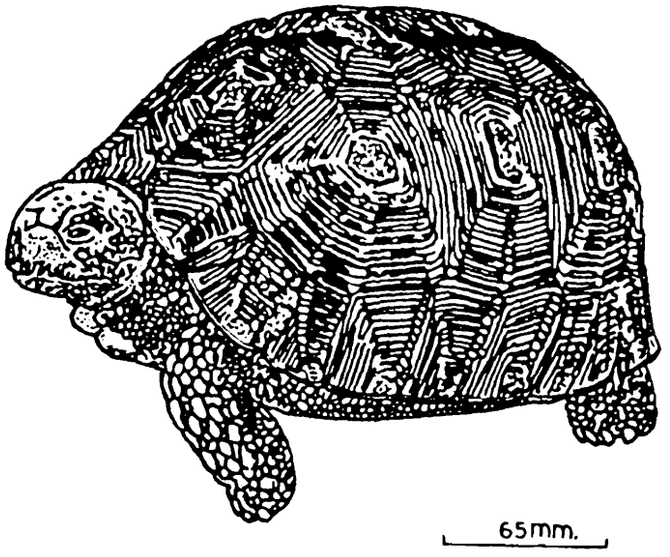
28. *Geochelone platynota* (Blyth 1863)
(Figs. 129-131)

1863. *Testudo platynota* Blyth, *J. Asiat. Soc. Bengal*, 32:83 (type loc. Irrawaddy Vally; Brit. Mus. and Ind. Mus.; Z.S.I.)

1890. *Testudo platynota*, Boulenger, *Fauna Brit. Ind*: 22.

1931. *Testudo platynota*, Smith, *Fauna Brit. Ind.* 1 ; 140-141.

It is a small tortoise in which the maximum recorded length of carapace is 28 cm. The head is of moderate size; with a pair of prominent pre-frontal shields and a large frontal; the rest of the head is with smaller scales; upper jaws feebly tricuspid. Carapace (Figs. 129 &130) is highly domed, very convex but not much elongated; the vertebral and costal shields are not humped; lateral margins are almost vertical and posterior margin is feebly serrated. Nuchal shield is not present. Vertebral shields are 5 in number; first vertebral is longer than broad; second to fourth vertebrals are broader than long. Costals are 4 in number and are equal or less broad than vertebrals. Supracaudal shield is undivided and incurved. Marginals are 22, excluding the supracaudal shield, these are slightly serrated. Plastron (Fig. 131) is large, notched anteriorly and posteriorly and is made up of paired gular, himeral, axillary, pectoral, abdominal, inguinal, femoral and anal shields; the sututre between the ab-



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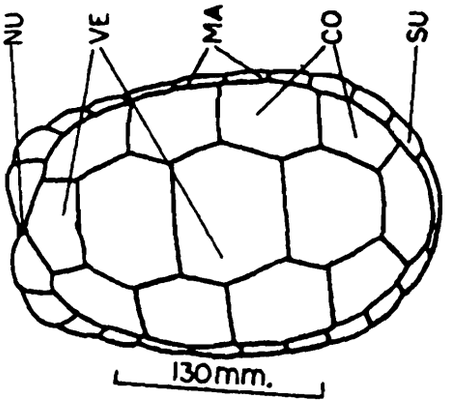

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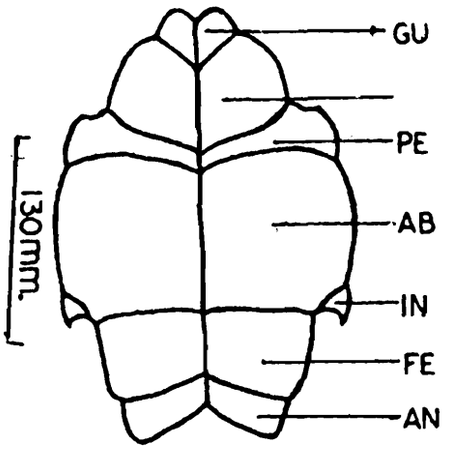

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Figs. 129–131. *Geochelone platynota* (Blyth).
129. Entire lateral view; 130. Carapace; 131. Plastron.

dominal shields is longest and the shortest suture is between the pectoral shields, which are very narrow; axillary shields smaller than the inguinal fore arms with large, pointed, bony scales; heels are with flat scales; back side of thighs are with a patch of enlarged, flat or pointed, spur-like scales. Tail terminating with a spur-like scale. General colouration is yellowish, with upto six dark radiating lines on each scale; areolae is yellow; plastron is yellowith, in some adult individuals a regular dark brown spot is available; each shield is edged with dark brown lines. Head and limbs are yellowish, larger scales on the limbs are bright yellow.

Distribution : Burma (widely distributed in Upper Burma and is found in Southern Burma up to Moulmein)

Habits and habitat : Strongly terrestrial and herbivorous. The eggs are large

(55X40 mm.) and are deposited at the end of February.

Status : Status in the wild condition is not known. Possibly vulnerable, suspected to be threatened on account of its excessive exploitation by man for flesh and eggs. Burmese are extremely found is eating this tortoise.

YELLOW TORTOISE OR RED-NOSED TORTOISE OR YELLOW-HEADED TORTOISE

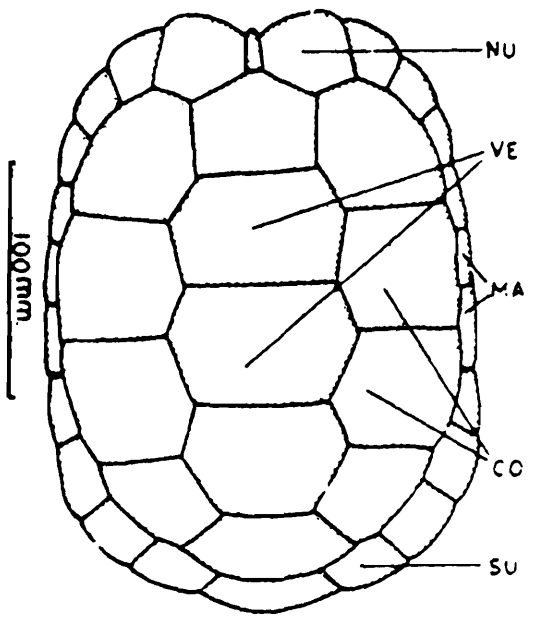
29. *Geochelone elongata* (Blyth 1853) (Fig. 132 &133)

1853. *Testudo elongata* Blyth, *J. Asiat. Soc. Bengal*, 22:639 (type loc. Tenasserim; Ind. Mus. Z.S.I.).

1890. *Testudo elongata*, Boulenger, *Fauna Brit. Ind.* : 20.

1913. *Testudo parallelus*, Annandale, *Rec. Ind. Mus.* 9 :76 (type loc. Chaibassia District, Chota Nagpur; Ind. Mus., Z.S.I.).

This is a small species of tortoise reaching slightly over 27 cm. in length. The head is of moderate size. The upper jaw is tricuspid and horny margins of jaws feebly denticulated. The skin at the top of head is with a pair of prefrontal shields and large frontal often subdivided and always present, the rest of the head is covered with smaller shileds. Carapace (Fig. 132) is elongated, narrow, flattened on the vertebral portion in adults. Marginals are generally serrated and flared on the posterior aspect of the carapace. Nuchal shields is present and somewhat elongated. Vertebral shields are 5 in number; first vertebral shield is as broad as long; second to fourth vertebrals are broader than long. Costal shields are 4 in number and are as broad as adjoining vertebrals. Supracaudal shield undivided and incurved. Marginals are 22 excluding the supracaudal shield. Plastron (Fig. 133) is large; truncate anteriory, deeply notched



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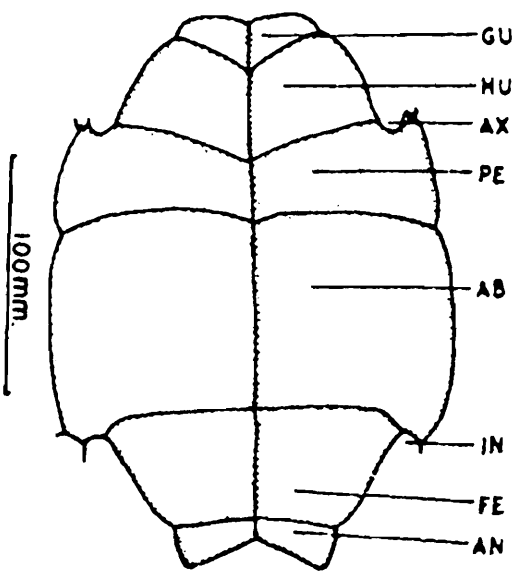

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Figs. 132 & 133. *Geochelone elongata* (Blyth). 132. Carapace; 133. Plastron.

posteriorly and is made up of paired gular, humeral, axillary, pectoral, abdominal, inguinal, femoral and anal shields; the longest median suture is between the abdominal shields, the shortest is between the anal shields which may be entirely separated by the anal notch; suture bewteen the pectoral shields is as long as or longer than that between the humeral in the adult; axillary shield is generaly smaller than inguinal. Fore limbs with large, imbricate, pointed scales, heels with large flat scales; a patch of enlarged flattened scales on the hinder portion of thigh. Tail longer and curved in the male than in the female and terminating in a horny tubercle. General dorsal colouration is yellow or greenish-yellow, with variable amounts of black markings. Large dark spots are present on marginals. Head is whitish-yellow but during the season reddish tinge is developed on the front wide of head in males. In juveniles the carapace is pure yellow with few black spots.

Distribution : India, Burma, Kampuchea, Loas, Malaysia, Thailand and Vietnam.

Habits and habitat : This species inhabits the low rocky-hilly areas. This tortoise has great tolerance for heat, being found on open hill sides in Thailand when the ground was unbearably hot. The species is herbivorous and mainly depends on a fruit diet. Generally two to four large oval eggs are laid in a single clutch.

Status : Indeterminate, suspected to be threatened on account of habitat destruction and over exploitation of adults for flesh and due to international trade. In Thailand the population of this tortoise declined to a considerable level during the last 15 years on account of human predation and urbanisation.

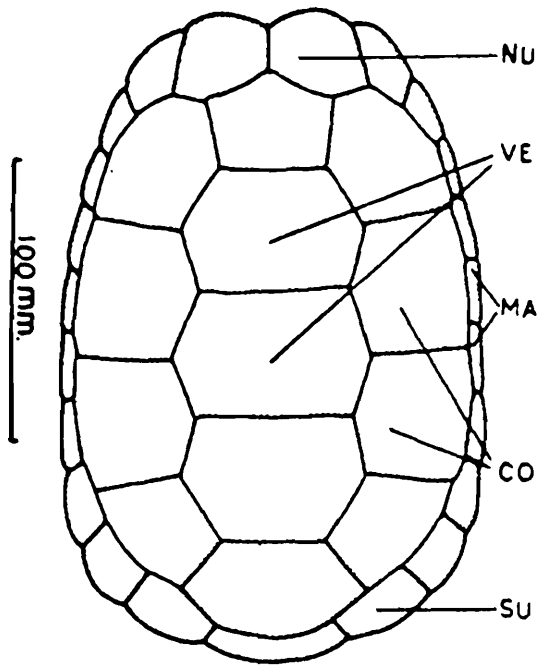
Conservation : Listed in Appendix II of the CITES which implies that commercial trade is allowed providing a permit from the country of export is obtained. The main exporting country of this species is Thailand which sent about 3800 specimens to the U.S.A., the Federal Republic of Germany, Switzerland and the United Kingdom since 1975. In India there is a strict ban on its export since 1979. It will be most useful if the exact status of this species is assessed throughout its range.

TRAVANCORE TORTOISE
30. *Geochelone travancorica* (Boulenger 1907)
(Figs. 134 &135)

1907. *Testudo travancorica* Boulenger, *J. Bombay Nat. Hist. Soc.* 17:560, 2 pls (type loc. Travancore Hills; Brit. Mus.).

1931. *Testudo travancorica*, Smith, *Fauna Brit. Ind.* 1:143-144.

This is a moderately large terrestrial hill tortoise reaching up to 30 cm. in length and weigh up to 3.75 kg. The head is of moderate size and its upper jaw is tricuspid; horny margins of jaws feebly denticulated. The top of the head is covered with large, Moderate and small shields; frontal shields paired. Carapace (Fig. 134) is rigid, oval, more or less dome-shaped with a slightly flared margin; nuchal shield is not present; vertebrals are 5 in number, first vertebral as broad as long and rest are broader than long. Costals are 4 in number and are less broad than vertebrals. Marginals are 23, including a single narrow supracaudal shield; two anteriormost peripheral marginals are largest and subtriangular; lateral marginals are quite thin and narrow. Plastron (Fig. 135) is large, truncate anteriorly, deeply notched posteriorly and is made up of



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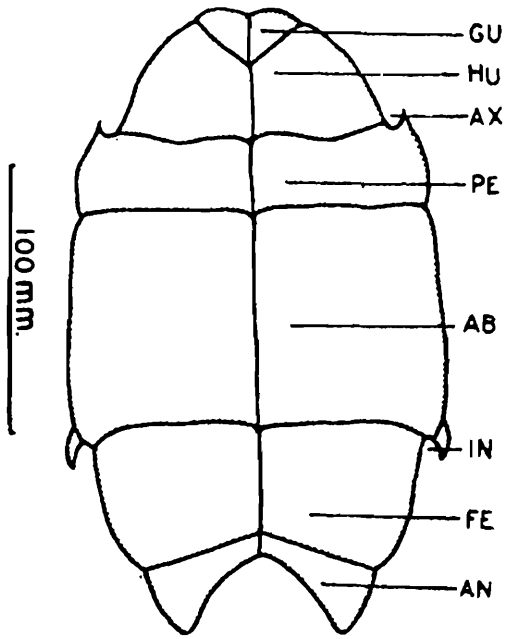

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Figs. 134 &135. *Geochelone travancorica* (Boulenger). 134. Carapace; 135. Plastron.

paired gular, humeral, axillary, pectoral, abdominal, inguinal, femoral and anal shields; the suture between the abdominal shields is largest and the shortest suture is between the anal shields; in many specimens anal shields are absolutely separated by the deep anal notch, suture between the pectoral shields is shorter than that between the humeral shields; axillary shield is smaller than the inguinal shield. Outer side of the fore limb is provided with distinctly large, imbricate, pointed scales. Tail is moderately long and terminates into a horny tubercle. It is longer and curved in the male than in the female. General colouration of the shield is quite variable from light brown, greenish-yellow or pale yellow. Shields are generally with a large dark blotch and edged with a lighter band, or yellow with dark band around. In most of the specimens the plastron is having black spots on the abdominal shields. The colouration of head is somewhat light greenish with a tinge of yellow. Limbs are with numerous irregular light black spots.

Distribution : India : Kerala Travancore Hills, Cochin forests and western slopes of the southern extremity of western Karnataka (hilly areas of Mercara).

Habits and habitat : This moderately large tortoise prefers a hilly, rain forest terrain up to an altitutde of 1000 meters or so. Nothing is known about its biology except that breeding season extends from November-January and six small to medium, oval eggs are laid in a single clutch. Food comprises mostly vegetable material. This tortoise has got a strong liking for mushrooms and in captivity relishes fruits (mango, jackfruit and banana), boiled rice, backed bread and leaves of grass.

Status : The species is nominally protected by legislation and is suspected to be threatened by habitat loss and human consumption. In recent past the species was available in fairly good numbers all over the range. Its flesh is relished by the local

people in Kerala and the animal is hunted immediately, the moment it is sighted by any tribal or any labourer working in a cardamom plantation, the tribals and other native track these tortoises by tracing their paths by observing the stubs of small mushrooms which they consume and relish.

Conservation : Listed in Appendix II of CITES which implies that commercial trade is allowed provided a permit from the country of export is obtained, this can provide a method of monitoring trade levels. Commercial export of this species is also banned, along with other reptiles since 1979. After assessing the exact status in the remaining rain forest habitat, a detailed study of biology and ecology might help in formulating suitable management plans to conserve this species along with its unique diminishing rainforest biotope.

Captive breeding : Nothing is known. Auffenberg (1964) has given an interesting account of its courtship and breeding colour change in captive male specimens.

31. *Geochelone emys* (Schlegel & Muller 1844)
(Figs. 136-138)

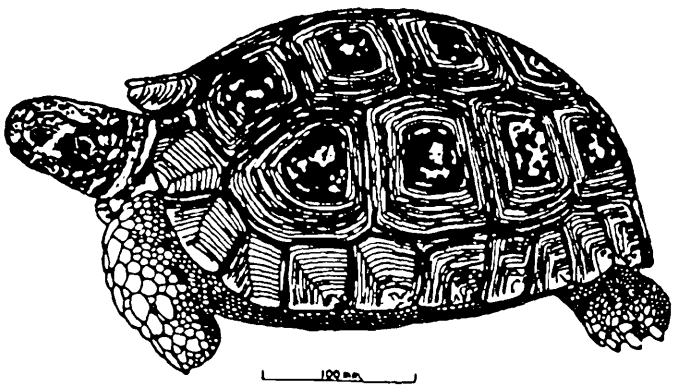
1844. *Testudo emys* Schlegel & Muller in Temminck *Verh. Ned. Ind. Rept.* 34, pl. 4 (type loc. Sumatra; Leiden Mus.).

1890. *Testudo emys*, Boulenger, *Fauna Brit. Ind.* 22.

1931. *Testudo emys*, Smith, *Fauna Brit. Ind.* 1 : 144-145.

This is a large terrestrial species, largest of the Asiatic tortoises, reaching slightly over 47 cm. in length and weighs 31 kg. or even more. The head is comparatively massive and its upper jaw is feebly hooked. The top of the head is covered with large symmetrical shields like frontal and two pairs of shields anterior to it signify the most constant character. Carapace (Figs. 136 &137) convex or domeshaped, depressed on the vertebral region in juveniles but slightly elevated in adults; anterior and posterior margins are flared and serrated; nuchal shield is small to moderate; vertebrals are 5 in number and are broader than long. Coastals are 4 in number and little less or as broad as vertebrals. Marginals are 25 (including on nuchal and a pair of supra caudals which are quite thin and narrow), those on sides are quite narrow. Plastron (Fig. 138) as large, sometimes larger than carapace owing to the extended gular shields slightly notched anterirly and deeply notched posteriorly, it is made up of paired gular, humeral, axillary, pectoral, abdominal, inguinal, femoral and anal shields; the suture between the abdominal shields is much larger than that between any of the other plastral shields; pectoral shields are usually widely separated from one another; inguinal shields large, often divided into two, axillary shield smaller. Fore-limbs with five claws, their front is having pointed, bony, imbricate scales, forming four or five longitudinal series. Hind limbs are four clawed, with large, pointed scales on the sole and heel; adults have a greatly enlarged conical scute on the back of the thigh and this is why it is known as six-footed tortoise. Tail is moderate and terminates in a grooved supr-like tubercle. The measurements are : length of shell 470, breadth 340 and depth 195 mm. Shell dark brown or blackish. Head and limbs are blackish.

Distribution : India : Cachar and Naga Hills of Nagaland. Elsewhere : Bangladesh



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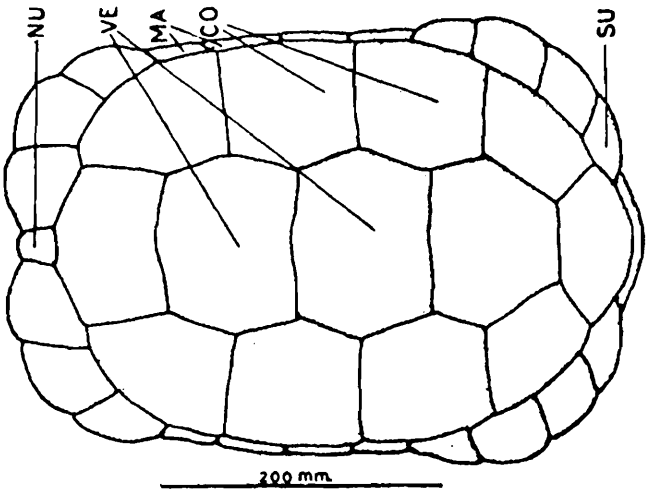

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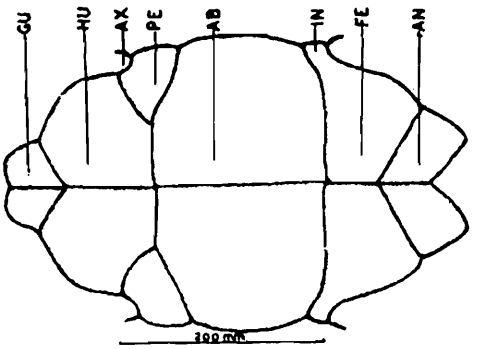

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Figs.136–138. *Geochelone emys* (Schlegal & Muller). 136. Entire lateral view; 137. Carapace; 138. Plastron.

(eastern hilly areas), Burma (hilly areas), Thailand (peninsular part), Malaysia (hilly areas of western Malaysia) Sumatra, Borneo (Sabah and Sarawak).

Habits and habitat : This slow, docile and considerably large tortoise prefers to live in hilly forested areas where plenty of water for its drinking is available. It lives mainly on the vegetable material available in forests but the diet is supplemented by a variety of invertebrates and small amphibians. Not much is known about its breeding habits except that is lays 5-8 eggs (50x43 mm. in length and breadth) in a clutch.

Status : Ruthless overexploitation of adults for protein-rich flesh and eggs is going on over much of its range. The species has become extremely rare and is considered threatened in Bangladesh, India and Thailand. In Malaysia also the population has considerably declined during the last 20 years on account of human predation and urbanisation.

Conservation : Listed in Appendix II of the CITES which implies that commercial trade is allowed providing a permit from the country of export is obtained. The main exporting country of this species is Thailand which sent about 2000 specimens to

U.S.A., the Federal Republic of Germany and Switzerland since 1975. In India there is strict ban on its export since 1979. It will be most beneficial if the exact status of this species is assessed throughout its range. Further detailed studies in ecology and biology of this tortoise will lead so as to formulate suitable management plans for its conservation.

Captive breeding : It is being tried in Malaysia. About 15 specimens are kept in Kuala Lumpur Zoological Garden.

IMPRESSED TORTOISE
32. *Geochelone impressa* (Gunther 1882)
(Figs. 139-141)

1882. *Geoemyda impressa* Gunther, *Proc. Zool. Soc.* 343, figs. (type loc. Siam; Brit. Mus.).

1890. *Testudo emys*, Boulenger, *Fauna Brit. Ind.* 22 (in part).

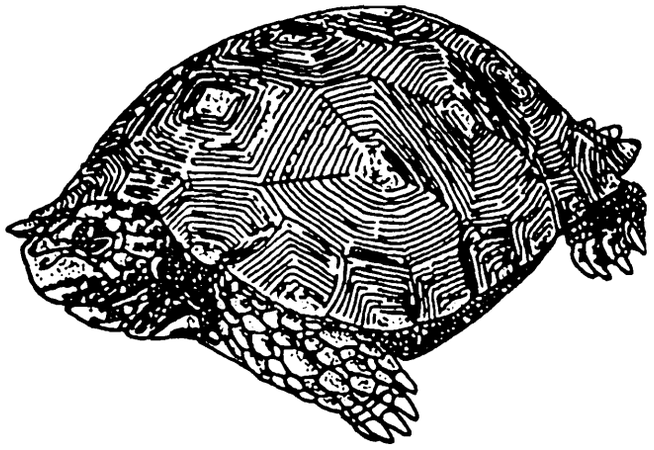
1931. *Testudo impressa*, Smith, *Fauna Brit. Ind.* 1 ; 145-146.

This is a medium sized tortoise whose carapace length never exceeds 28 cm. The head is comparatively massive and its upper jaw is feebly hooked. The top of head is covered with large symmetrical shields like frontal and two pairs of shields anterior to it. Carapace (Figs. 139 &140) much flattened on the vertebral region; vertebral shields are 5 in number and are flat or concave in most of the adult individuals; costals are concave and 4 in number; marginals are 25 (including one nuchal and a pair of supracaudals); carapace is slightly reverted and strongly serrated on both the anterior and posterior margins (marginals strongly splayed out and form serration). Nuchal shield is present, it is quite large and triangular; vertebral shields are broader than long, as broad as or broader than the adjoining costal shields; supracaudal shield is divided and quite prominent. Plastron (Fig. 141) is large but not longer than the carapace, openly emarginate anteriorly, deeply notched posteriorly; it is made up of paired gular, humeral, axillary, pectoral, abdominal, inguinal, femoral and anal shields; the longest suture is between the abdominal shields; the shortest suture is between the pectoral shields; inguinal shields large, often divided into two; axillary shield smaller. Fore-limibs with five claws with pointed, bony imbricate scales arranged in many series. Hind limbs are four clawed, with large, pointed scales on the sole and heel; limbs are generally covered with heavy scales. Tail is moderately long. The measurement are : length of shell, 260-280 mm.; breadth, 195 mm.; depth, 95 mm. General colouration of dorsum is light brown or dull brown, yellow; many individuals mixed with dark radiating markings; border of the carapace is comparatively dull in colouration than the other parts of shell. Plastron is brownish or yellowish-brown with few more darker marks (brown); in few individuals the plastral shields have dark rays. Head is light yellow. Limbs are brownish to black. Juveniles are light yellowish-brown above, with fine black dots.

Distribution : Burma, China, Kampuchea, Malaysia, Thailand and Vietnam.

Habits and habitat : This is a hill species and lives at considerable altitudes. Nothing is known regarding other habits.

Status : The species is suspected to be threatened on account of large scale exploitation by man for flesh and other purposes. It has been recorded by CITES parties



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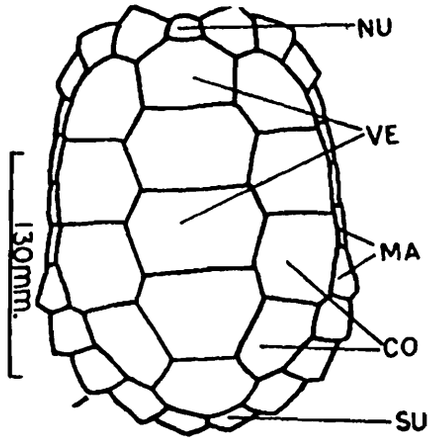

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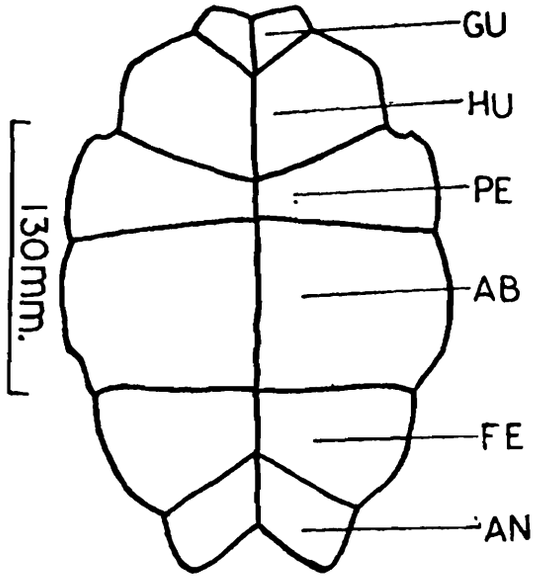

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Figs. 139–141. *Geochelone impressa* (Gunther). 139. Lateral view; 140. Carapace; 141. Plastron.

that 2200 tortoises were exported from Thailand and Malaysia to U.S.A., Germany and Switzerland between 1975-1979. The exact status can not be ascertained until and unless the wild populations are known in its range.

Genus 18. ***Testudo*** Linnaeus 1758

1758. *Testudo* Linnaeus, (in part), *Syst. Nat. Ed.* 10 : 197 (type Testudo graeca)

1890. *Testudo* Boulenger, *Fauna Brit. Ind.* 19.

1931. *Testudo* Smith, *Fauna Brit. Ind.* 1 : 136.

The main generic characters are : In skull the alveolar surface of upper jaw with a median ridge; premaxillaries are devoid of any median ridge; maxillaries have not

participation in the formation of the roof of palate; foramina on the aterior palatine is small or large, concealed or visible; prootic bones are hidden in the anterior-dorsal aspect under parietal; quadrate may or may not enclose the stapes; surangular is almost equal to the prearticular in height; third and fourth cervical vertebrae has got a biconves centrum. Carapace is not hinged; vertebral plates are hexagonal, short-sided posteriorly or alternatively octagonal and quadrilateral; the outer side of the third costal shield is almost as long as, or a little than the fourth costal shield; submarginal shield is not available; generally a single suprapygal shield is present. Plaston is with a hinged posterior lobe in one or both sexes; gular region is slightly thickened; gulars are paired longer than broad. Limbs more or less cylindrical, the hinder limbs are club-shaped, covered with enlarged, often bony scales. Digits very short and not webbed. Tail short, not longer in the young than in the adult.

33. *Testudo horsfieldi* Gray 1844
(Figs. 142-144)

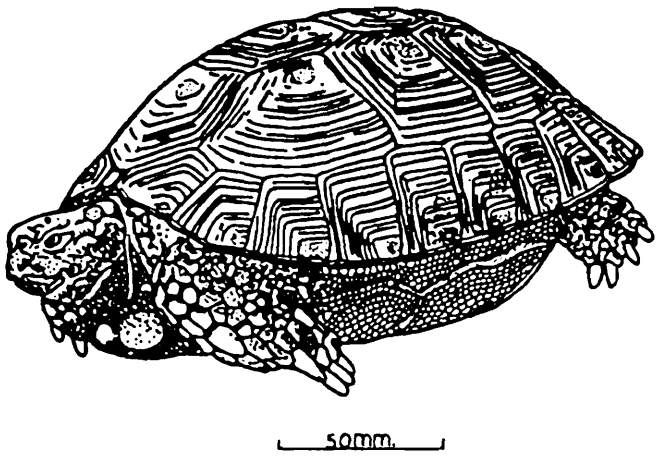
1844. *Testudo horsfieldi* Gray, *Cat. Tort. Cro. & Amphis. Brit. Mus.* London. 7.

1906. *Testudo baluchiorum* Annandale, *J. Asiat. Soc. Bengal*, 2 : 75 & 205, pl. 2, fig. 1 (type loc. Baluchistan; Ind. Mus.).

1931. *Testudo horsfieldi* Smith, *Fauna Brit. Ind.* 1 : 146-147.

This is quite a small tortoise whose shell length varies between 15-23 cm. in adults. The head is small and its upper jaw is tricuspic. Top of head always with symmetrical shields like frontal and a large pair of prefrontals. Carapace (Figs. 142 & 143) is broad, rounded and depressed, flattened on the vertebral region; its anterior and posterior margins are slightly expanded, crenulated in the juveniles; vertebral shields are 5 in number, considerably broader than long, about as broad as the adjoining costal shields; Nuchal sheild is long and narrow. Costal shields are 4 in number; marginals are 24, including one nuchal and a supracaudal. Plastron (Fig. 144) is large, solid, truncate or openly emarginate anteriorly, notched posteriorly, flat in both sexes and is made up of paired gular, humeral, axillary, pectoral, abdominal, inguinal, femoral and anal shields; the longest suture is between the abdominal shields; the shortest suture is between the femoral or the pectoral shields; axillary and inguinal shields are small. Fore limbs are with 4 claws, fore arm with enlarged, pointed, imbricate, bony scales. Hind limbs are with 5 claws, heel and plantar surface of foot are with enlarged, pointed, imbricate, bony scales; a group of pointed small spur like scales are present on the back side of the thigh; tail ends into a horny, curved nail like tubercle, which is longer in the males than in the females. Dorsal colouration is yellow to olive, with black spots on each shield. Plastron is also of the same colouration, but may be slightly darker; blotches of black colour may be present on a definite place on each shield of the plastron, or may cover almost the entire area; in some individuals the black blotches are absent altogether from the plastron. Head and limbs are yellowish.

Distribution : Range extends from north-eastern shores of the Caspian sea to Castward through U.S.S.R. (Kazakhstan to Lake Zaysan), Waziristan, Eastern Iran, Afghanistan and N.W. Pakistan (N.W. Baluchistan).



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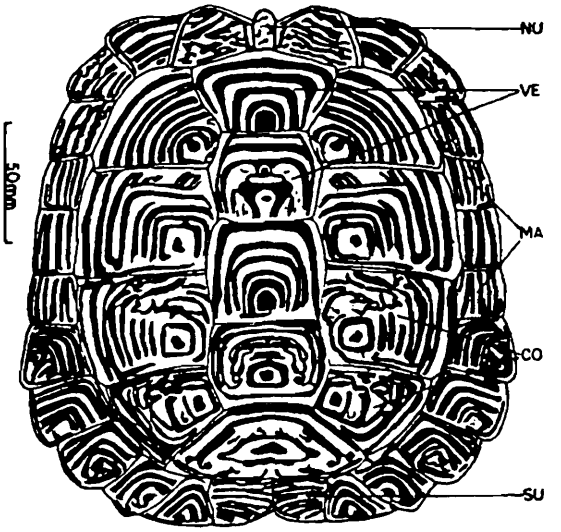

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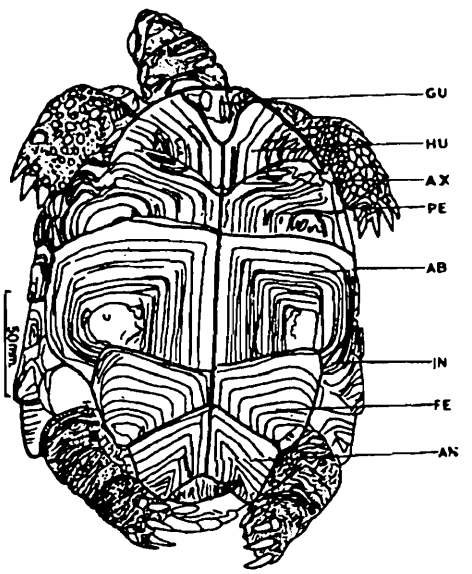

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Figs. 142–144. *Testudo horsefieldi* Gray. 142. Entire lateral view; 143. Carapace; 144. Plastrom.

Habits and habitat : This tortoise feels quite confortable even at an altitude of 2400 metres and makes it abode in grassy places near springs or small streams in hilly, rocky terrain. In the hot season (May and June) these tortoises take refuge in shallow burrows under the stones, boulders and rock crevices. They come out for feeding during the early morning and evening. The main food of this tortoise comprises the flower, fruits and thick fleshy leaves of numerous wild plants. In extreme winter months it digs long burrows for shelter with the aid of its strong fore limbs and well developed claws. According to Smith (1931) a female killed toward the end of May contained five fully formed eggs measuring 50x35 mm. in size. According to Minton (1966) the eggs of this tortoise measure 41x28 mm. in size.

Status : The species is vulnerable. According to the CITES records, 105687

specimens were recorded by the CITES parties in 1978; 95000 specimens were exported by USSR to the Germany in 1979; 9476 specimens were exported by Germany to the Switzerland during 1975 to 1979, on account of various reasons.

Famly VI. TRIONYCHIDAE, Bell 1828

1828. Trionychidae Bell, *Zool. Joun.* 3 : 515.

1890. Trionychidae Boulenger, *Fauna Brit. Ind.* 9.

1931. Trionychidae Smith, *Fauna Brit. Ind.* 1 : 147.

This family comprises the soft-shelled fresh-water or mud turtles in which head and neck is completely retractile. Their neck which is exceedingly long and flexible bends in a sigmoid curve in a vertical plane; ear is hidden; last cervical vertebra articulate with the first dorsal by a double facet on the centrum and by the zygapophysis; pterygoid bones are separated from each other and basisphenoid reaches up to palatine bones; jaws are absolutely hidden under fleshy lips; snout ends in a proboscis and much elongated. Pelvis not anchylosed to the carapace and plastron. Carapace and plastron covered by a continuous layer of soft skin; without epidermal shields; the sides of the hinder portion of carapace are quite flexible; epi- plastron is separated from hypoplastron by a A-shaped entoplastron; plastron united to carapace by ligamentous tissue; marginal bones of the carapace are missing or form an incomplete series, not attached to the ribs. Limbs are fully webbed, with only three claws on each foot; phalanges elongate, fourth digit with four or more phalanges, only the three inner digits are clawed, forelimbs are semi-paddle shaped.

Key to the Genera

1. Plastron with soft, semicircular flaps, which permit the retracted hind feet to be completely concealed. Marginal bones are present. Front part of the plastron is also flexible and quite suitable for the closure of the anterior shell opening. Plastron with seven callosites in the adult. Carapace without definite pattern, yellow spots may be present or absent. Snout comparatively short ..... ***Lissemys***
2. Plastron without flexible skin-flaps and without cutaneous femoral valves. Marginal bones are not present. Plastron with four callosites only in the adult. Carapace with a definite pattern in juvenile specimens. Snout rather long.

A. Head very large, its post-orbital arch is so narrow and reduced that it is represented by an edge; neural shields separate all the costal plates medially ..... ***Dogania***

B. Head small to moderate, its postorbital arch not reduced; neural shields do not separate all the costal plates, last one or two pairs of costal plates are in contact with one another medially.

i. Orbit nearer the temporal fossa than the nasal fossa; postorbital arch narrower than diameter of the orbit; proboscis as long as the eye-opening ..... ***Trionyx***

ii. Orbit nearer the nasal than the temporal fossa.

a. Postorbital arch slightly broader than the diameter of the orbit; proboscis very short; not more than half the length of the eye-opening ..... ***Pelochelys***

b. Postorbital arch two times broader than the diameter of the orbit; proboscis not much short and as long as the eye-opening ..... ***Chitra***

Genus 19. *Lissemys* Smith 1931

1809. *Trionyx* (in part), Geoffroy, *Ann. Mus. Hist. Nat. Paris*, 14 : 1.

1931. *Lissemys*, Smith, *Fauna Brit. Ins.* 1 : 155.

Nuchal bone is butterfly-shaped; dorsal shield is with a prenuchal, marginal and series of posterior marginal bony plates; seven or eight neural plates forming a continuous series; eight pairs of costal plates, the last two pairs forming a median suture. Plastron is with a cutaneous femoral valve, under which the hind limb may be concealed; seven platral callositis with hypoplastron. Skull covex above; postorbital arch narrower than the orbital diameter; posterior margin of pterygoid is with a median ascending process which forms a suture with the opisthotic. Tail is very short. A single species with three sub-species inhabiting Indian Region.

Key to the Subspecies

1. First marginal bone much longer than the second in the adult; ectoplastral callosity is generally small in the adult; head and carapace with yellow spots ..... *L.p. punctata*
2. First marginal bone much longer than the second in adult; ectoplastral callosity is generally moderate in the adult; carapace is uniform brown or blackish; head with black longitudinal lines, these are most prominent in the juveniles ..... *L.p. granosa*
3. First marginal bone smaller than the second; ecoplatral callosity very large in the adult; dorsum brownish, carapace is with black spots or reticulations ..... *L.p. scutata*

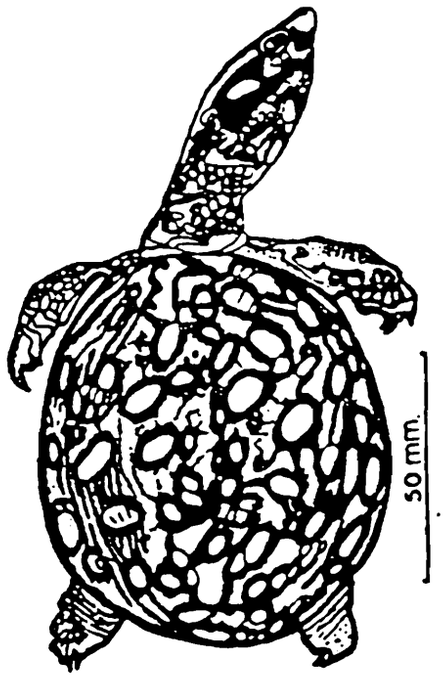
NORTH INDIAN FLAP-SHELLED TURTLE
34. *Lissemys punctata punctata* (Lacepede 1788)
(Figs. 145 &146)

1788. *Lissemys punctata punctata* Lacepede, La Tortue chagrinee. *Hist. Quad Ovip.* 1 : 171, pl. 11.

1931. *Lissemys punctata punctata*, Smith, *Fauna Brit. Ind.* 1 : 157.

This is a small flat turtle whose length hardly exceeds more than 24 cm. The head is moderately large, the snout is short and broad, its length is less than the length of the eye opening. The carapace (Fig. 145) and platron (Fig. 146) covered by a continuous sheet of soft skin and their callosites are finely granulated.

Skin of dorsal disc of juveniles longitudinally plaited. The lateral and the hinder portions of the carapace are most flexible. Neural bones are two in number and rest between the first pair of costal plates. First marginal bone in the adult is very large, much longer than the other marginal bones. Plastron is with soft, semicircular flaps, which accomodate the retracted hind feet to be totally concealed; front portion of the plastron is quite flexible and permits and closure of the anterior shell opening quite effectively. Plastron is with seven callosites in the adult, namely paired hyo-hypo., xiphi., and epiplastral, and a single entoplastral (quite small in adults). Limbs are fully webbed, with only three claws on each foot. Tail is very short. Olive-brown above. Carapace is grey-green, with numerous blackbordered yellow spots, irregularly arranged and with a light yellow marginal rim.



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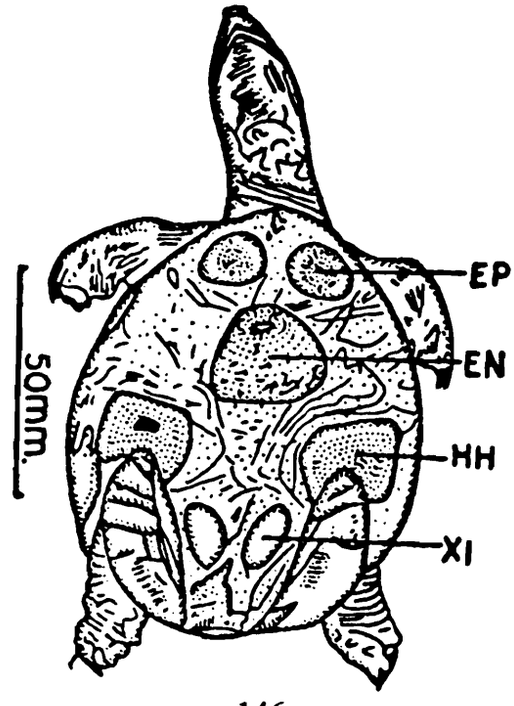

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Figs. 145 & 146. *Lissemys punctata punctata* (Lacepede). 145. Carapace; 148. Plastron.

Distribution : India : Ganga river system, Sikkim, Kutch and Andaman Islands. Elsewhere : Bangladesh, Burma (Akyab), Nepal, Pakistan (Sind river system) and Sri Lanka.

Habits and habitat : The subspecies prefers to live in shallow, muddy, ditches, lakes and marshes. It is a carnivorous turtle and feeds mainly on frogs, fishes, shrimps and snails. Nothing is known about its breeding habits except that it lays 12 eggs in a single clutch.

Status : Suspected to be threatened on account of ruthless killing and overexploitation of adults and their eggs for protein-rich food. Habitat destruciton is another principle factor of threat to the species. The nests of these turtles are frequently raided by predators like man, otters, mangooses, jackals and dogs. The construction of hydro-electric dams and barrages has greatly checked the movements of the turtles its breeding grounds.

Conservation : Nominally protected by legislation and export of adults and their products is prohibited. This subspecies is already in the Appendix I of IUCN. Exact data on the population are not available but it has been drastically reduced. A detailed study on the status and ecology will lead so as to formulate suitable management plans to conserve this endangered subspecies.

SOUTHERN FLAP-SHELLED TURTLE

34a. ***Lissemys punctata granosa*** (Schoepff 1792)

(Figs. 147 & 148)

1792. *Testudo granosa* Schoepff, Hist. Test. 127, pls. 30 A&B (type loc. Coromandal coast; Mus. Blochianum)

1890. *Emyda vittata*, Boulenger, *Fauna Brit. Ind.* 18.

1931. *Lissemys punctata granosa* Smith, *Fauna Brit. Ind.* 1 : 158.

Other taxonomic characters and size etc. are same as available in the *Lissemys p. punctata*

except that the first marginal bone is smaller than the second (Fig. 147), entoplastral callosity is very large in the adult individuals and in certain specimens it is in contact with the hyo-hypo-plastral callosites (Fig. 148). It differs in colouration also and the carapace is uniformly olive-brown, juveniles sometimes with light longitudinal markings on the greenish head.

Distribution : India : Peninsular India. Elsewhere : Sri Lanka.

Habits and habitat : It prefers to live in ponds and tanks with muddy bottoms and embankments. It is strictly carnivorous and has got a great liking for fish but eats frogs, shrimps and snails also. It is a very pugnacious creature and bites immediately even on a gentle handling. It lays 10-12 spherical eggs in a single clutch; eggs measuring 30-33 mm. in diameter.

Status: Suspected to be threatened on acccount of large scale killing for eggs and adults, habitat destruction and urbanisation on the nesting sites.

Conservation : Nominally protected by legislation and any export of adults and their products is prohibited. This turtle is included in Appendix I of IUCN. Exact data on the population is not availabe, but it has been considerably reduced. A detailed study on the status and ecology will lead so as to formulate suitable management plans to conserve this endangered subspecies.

34b. ***Lissemys punctata scutata*** (Peters 1868)
(Figs. 149 &150)

1868. *Emyda scutata* Peters, *Monatsber. Acad.* Berlin, 449 (type loc. Pegu; Zool. Mus., Berlin).

1931. *Lissemys punctata scutata* Smith, *Fauna Brit. Ind.* 1 : 159.

Other taxonomic characters and size etc. are same as available in the typical form except that the first marginal bone is smaller than the second; entoplatral callosity in the adult is very large, in some individuals it is even in contact with the hyo-hypoplastral callosites. It differs in the colouration also as follows. The carapace is olive-brown, with indistinct dark spots in the juveniles which break up in to dark reticulations in the adult. A faint dark stripe passes backwards from the eye and another between the eyes may be present.

Habits and habitat : The species is mud dwelling and carnivorous, feeds on frogs, shrimps and snails. According to Smith it lays eggs in December, scraping a hole for them in mud and then covering them up. The eggs measure about 25 mm. in diameter.

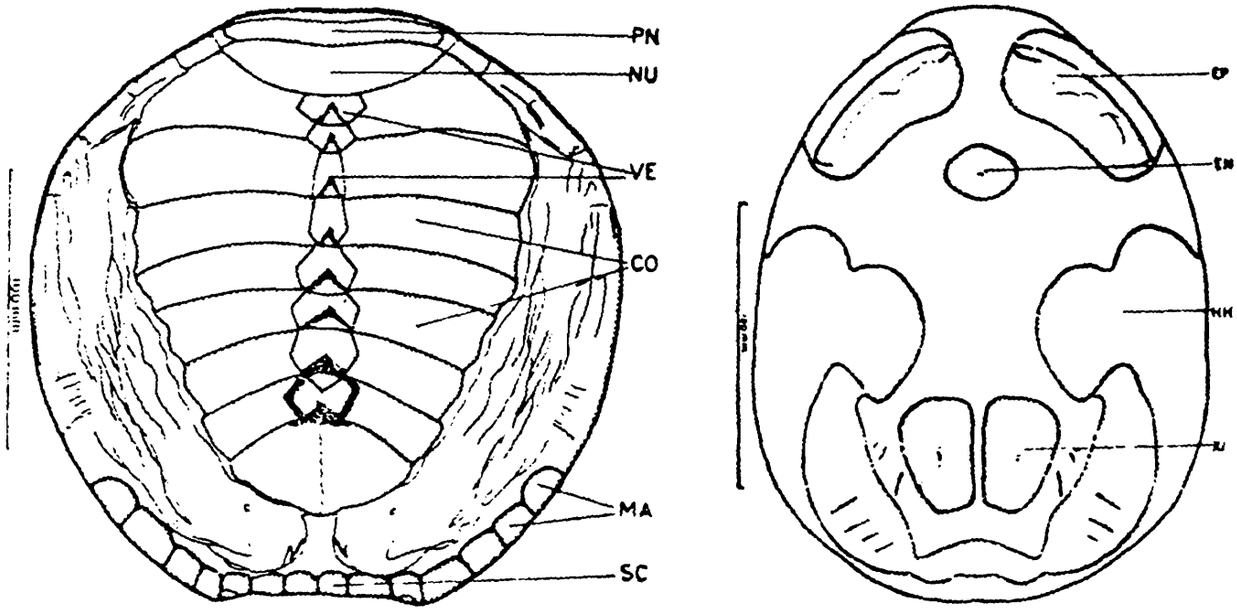
Status : Suspected to be threatened on account of over-exploitation of adults and their eggs for food.

Genus 20. ***Pelochelys*** Gray 1864.

1864. *Pelochelys* Gray, *Proc. Zool. Soc.* 89 (type *Pelochelys cantoii*)

1931. *Pelochelys* Smith, *Fauna Brit. Ind.* 1 : 160.

The main generic characters are as follows : Skull is broad and flat dorsally; postorbital arch is slightly broader than the diameter of the orbit; posterior border of pterygoid is free and without ascending process; outer extreme end of the nuchal shield overlies the second dorsal rib; seven pairs (rarely eight) vertebral sheidls form



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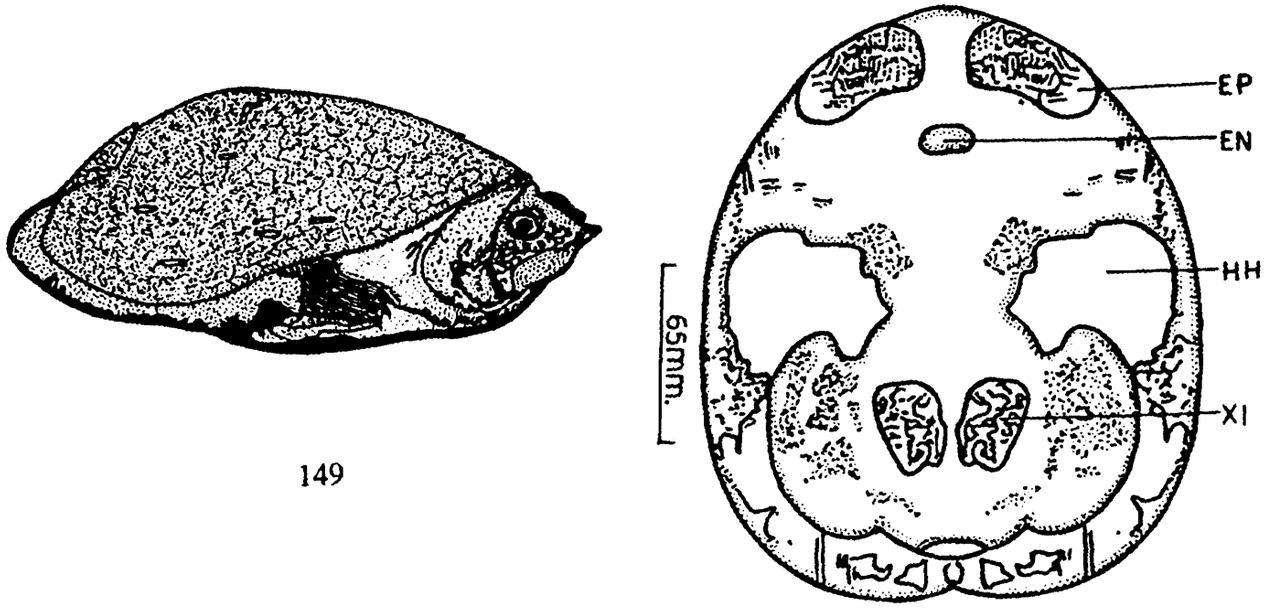
Figs. 147 & 148. *Lissemys punctata granosa* (Schoepff). 147. Corapace; 148. Plastron.



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Figs. 149 & 150. *Lissemys punctata scutata* (Peters). 149. Lateral view showing Carapace; 150. Plastron

a continuous series; eight pairs of costal plates are present, the last one or two pairs are in contact in the mid-line. Plastron is without flexible skin-flaps and without cutaneous femoral valves. Marginal bones are not present. Plastron with four callosites only in adult. Hyoplastron distinct from hypoplastron. Proboscis is very short, not more than half the length of the eye-opening. Limbs are exposed. Tail is very short. It is a monotypic genus.

35. *Pelochelys bibroni* (Owen 1853)
(Figs. 151 & 152)

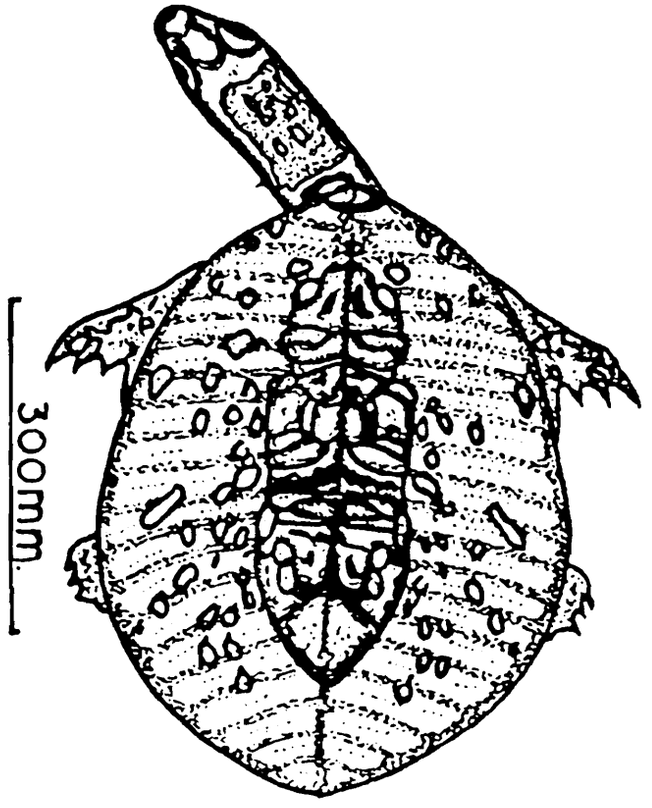
1853. *Trionyx (Gymnopus) bibroni* Owen, *Osteol. Ser. R. Coll. Surg.* 1 : 185 (type loc. Australia; coll. Surg.).

1890. *Pelochelys cantoris*, Boulenger, *Fauna Brit. Ind.* 15.

1931. *Pelochelys bibroni* Smith, *Fauna Brit. Ind.* 1 : 161.

It is a large turtle whose length sometimes exceeds even 60 cm. Head is small, broad; snout short, rounded; proboscis very short, a mere projection. Along with the characters, already given in the genus, the species is characterised by having a single vertebral (neural) shield between the first pair of costals (Fig 151) shields of the carapace are pitted and vermiculated.

Anterior limbs of epiplastra are short and broad, widely separated from one another; four well developed plastral callosities hyo-hypoplastral and xiphiplastral, in the adult. Dorsal colouration is olive, dotted all over with yellow; plastron is whitish.



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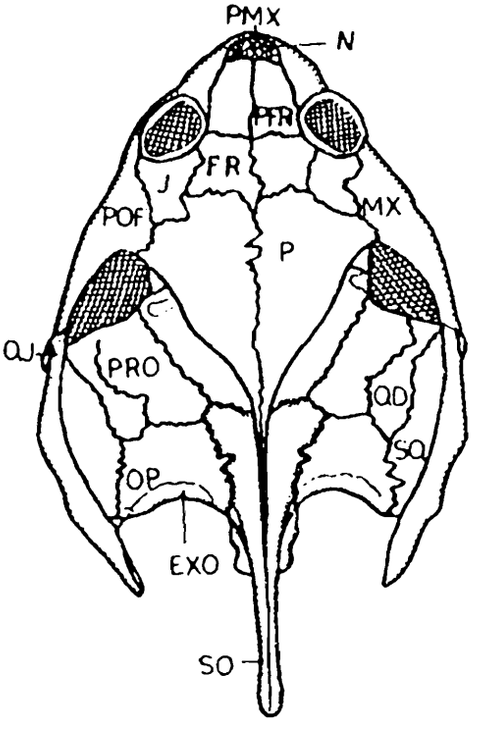

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Figs. 151 & 152. *Pelochelys bibroni* (Owen). 151. Carapace; 152. Skull (dorsal view).

Distribution : Burma; southern China (Foochow, Kwangtung, Canton and Hainan Island); Vietnam; Thailand; Cambodia; Laos; Malaysia Peninsula; Many of the Indonesian Islands, including Java, Sumatra, Borneo; New Guinea; Philippines (Luzon Islands).

Habits and habitat : This turtle is mainly the inhabitant of freshwater bodies like deep and slow-flowing rivers and streams. It goes quite freely up to large distance in the sea. It is quite sluggish and most docile and even on provocation will never make an attempt to bite. On extreme rough handling it may strike with great speed but never bites. Nothing is known regrading the feeding habits in the natural conditions. But this is certainly a carnivorous species as it devours the dead fish readily in the captivity. More than one nesting takes place in one season (December) and turtle lays as many as 28 eggs in a single clutch (diameter 30 mm.).

Status : The species is endangered over much of its range, on account of large scale exploitation for its eggs and flesh for food. Its flesh is considered as a delicacy.

Genus 21. ***Chitra*** Gray 1844

1844. *Chitra* Gray *Cat. Tort. Croc. & Amphis Brit. Mus.* 49. (type *Trionyx indicus*).

1890. *Chitra* Boulenger, *Fauna Brit. Ind.* 16.

1931. *Chitra* Smith, *Fauna Brit. Ind.* 1 : 162.

Skull is long, narrow, flat above; orbits are close to its anterior extremity; postorbital arch twice as broad as the diameter of the orbit; posterior border of pterygoids is free, without ascending process. Proboscis not much short and as long as the eye-opening, head small. Vertebral shields of carapace do not separate all the costal shields, last one or two pairs of costals are in contact with one another medially; outer end of the nuchal shield overlies the second dorsal rib; eight vertebral shields are present and they form a continuous series; eight pairs of costal shields are available, the last pair is in contact in the mid-line. Plastron is without flexible skin-flaps and without cutaneous femoral valves; plastron with four calosites only in the adult; hyoplastron is distinct from the hypoplastron, marginal bones are not present. Limbs are exposed. Tail is very short. The genus is monotypic.

NARROW-HEADED SOFT-SHELLED TURTLE
36. ***Chitra indica*** (Gray 1813)
(Figs. 153-157)

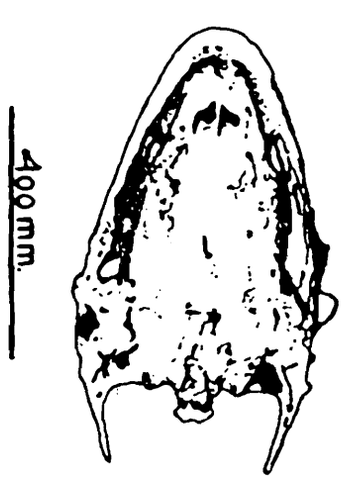
1813. *Trionyx indicus*, Gray, *Syn. Rept.* 47.

1890. *Chitra indica*, Boulenger, *Fauna Brit. Ind.* 16.

1931. *Chitra indica*, Smith, *Fauna Brit. India*, 1 : 162

This is a gigantic, flat soft-shelled species reaching to a length of 90 cm. or more. The head is quite small in comparison to the body, somewhat elongated; snout is rounded; proboscis about as long as the eye-opening. Skull (Figs. 153-155) is very long and narrow, flat above, the orbits are close to its anterior extremity; post-orbital arch twice as broad as the diameter of the orbit; posterior margin of the pterygoid is free and devoid of any ascending process. The alveolar surfaces of jaws are slightly ex-

panded, and the edges of jaws are extremely sharp. The eyes were displaced much forward. Carapace (Fig. 156) is remarkably pitted and vermiculated; a single neural plate rests between the first pair of costals; outer extremity of nuchal plate overlapping the second dorsal rib; eight neural plates form a continuous series; eight pairs of costal plates are present, the last pair is in contact with the mid-line. Hyoplastron is distinct from hypoplastron; anterior limbs of epiplastra are long and slender, widely separated from one another; four well developed hyo-hypo and xiphi plastral callosites are present in the adults (Fig. 157). Dorsal colouration is olivaceous yellow, with dark vermiculations or black dots in juveniles. In adults the black punctate markings are replaced by large angular markings of light yellow colour. Head and neck with light, black-edged longitudinal streaks and a Λ shaped mark in the mid-line commencing



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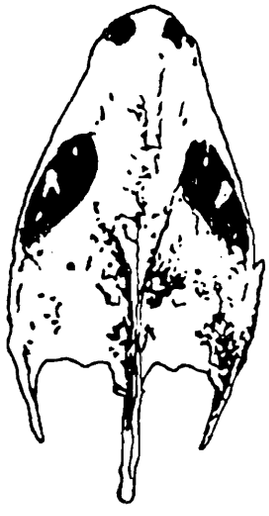

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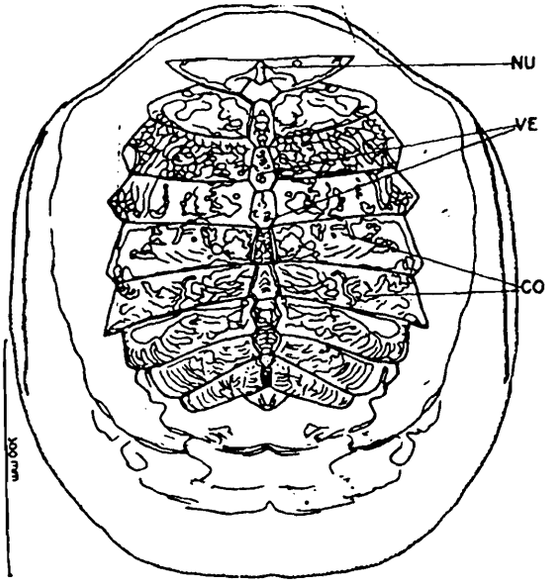
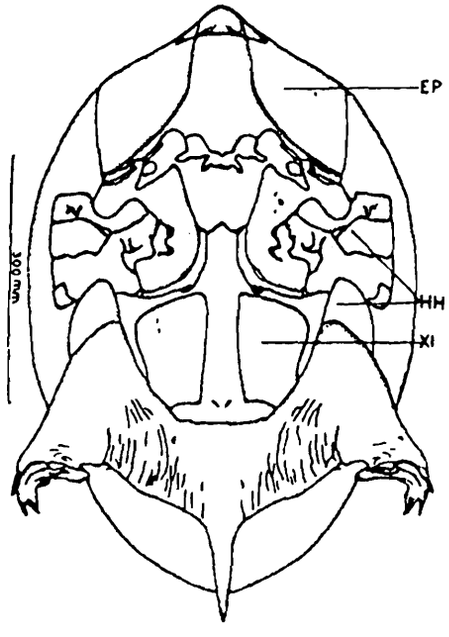


Carapace of Chitra indica (Gray)

156



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Figs. 153–155. *Chitra indica* (Gray). Skull 153. Dorsal view; 154. Ventral view; 155. Lateral view.
Figs.156 &157. *Chitra indica* (Gray). 156. Carapace; 157. Plastron.

just in front of the disc. In fully grown up and aged adults these markings become less distinct.

Distribution : India : Uttar Pradesh, Bihar and West Bengal. Elsewhere : Nepal, Pakistan, Malaysia and Thailand.

Habits and habitat : This species is most agile and prefers to live in shallow rivers with sandy bottoms and banks. This is most dangerous carnivorous fresh-water turtle and its food comprises mainly fish, gastropod molluscs and other small animals. On handling it suddenly shoots out its long neck and bites most savagely. It is capable of inflicting most severe wounds. It lays 8-10 spherical eggs in a single clutch; eggs measuring 36-42 mm. in diameter.

Status : Indeterminate, suspected to be threatened on account of excessive killing of adults and overexploitation of eggs for food. Other factors of threat are same as given in the case of other Trionychids.

Conservation : Nominally protected by legislation. Exact population estimates are not available but it has been considerably depleted in the recent past. A detailed study on the status and ecology will lead so as to formulate suitable management plans to conserve this endangered species.

Genus 22. ***Dogania*** Gray 1844

1844. *Dogania* Gray, *Cat. Tort. Croc. & Amph. Brit. Mus. 49 (Trinoyx subplanus)*

1931. *Dogania,* Smith *Fauna Brit. Ind.*, 1 : 164.

The main generic characters are : Skull is convex dorsally; postorbital arch is extremely narrow, its outer margin reduced to an edge; posterior border of pterygoid is free and without any ascending process. Snout is long, head very large. Vertebral shields are eight in number, which separate all the costal shields; costal shields are also in eight pairs, separated by the vertebrals (neurals). Plastron is without flexible skin-flaps and without cutaneous femoral valves; plastron with four callosities only in the adult; hyoplastron is distinct from the hypoplastron. Marginal bones are not present. Limbs are exposed. Tail is very short. The genus is monotypic.

37. ***Dogania subplana*** (Geoffroy 1809)
(Fig. 158)

1809. *Trionyx subplanus* Geoffroy, *An.. Mus. Hist. Nat. Paris*, 16 : 11. pl. 5 (type loc. unknown; *Paris Mus. Nat. Hist.*).

1890. *Trionyx subplanus,* Boulenger, *Fauan Brit. Ind.*. 11.

1931. *Dogania subplana,* Smith, *Fauna Brit. Ind,* 1 : 165.

This is one of the smallest of the soft shelled turtles, whose shell length never exceeds 26 cm in fully grown up adults. Head is very large; snout is at least as long as the opening of the eye; postorbital bar of the skull is extremely narrow; preneural bone is not present; mandibular symphysis is devoid of a median ridge; pleural bones are 8 in number, all are separated along the midline by the neurals. Carapace (Fig. 158) is flat, somewhat elongated, longer than broad: a single neural plate between the first

pair of costals: all the carapace shields are nicely pitted and vermiculated. Hyoplastron is distinct from the hypoplastron; anterior extensions of epiplastra are long and slender, almost touching one another in front of the entoplastron; four plastral callosites, hyo-hypoplastral and xiphiplastral, feebly developed, often absent. Dorsal colouration in young is rich chestnut brown, with fine black vermiculation. In adults the disc uniformly olive-brown or with a fine yellow dotting and with a prominent black vertebral stripe, two or three pairs of black ocellar spots are always present. Plastron is whitish or pale yellow. Head and limbs are olive-brown dorsally. A dark median streak is available on the neck, which emerges from between the eyes and two oblique streaks on either side, the upper pair meeting each other between the eyes; chin with black vermiculations.

Distribution : Burma, Thailand, Malaysia, Java, Sumatra, Borneo, Mergui Archipelago, Off Tenasserim, Singkep, Riau Archipelago, Philippine Islands.

This is certainly a distinctive species of the genus Doganis. The generic characters are so stable that I do not find any justification to place this species in the genus *Trionyx*.

Habits and habitat : The species is highly aquatic and prefers to live in fast running water (hill streams), and hides under the flat stones, and rock crevices, submerged in water. The species is mainly carnivorous. Nothing is known about the breeding habits.

Status : The species is vulnerable. Population is considerably reduced in recent years.

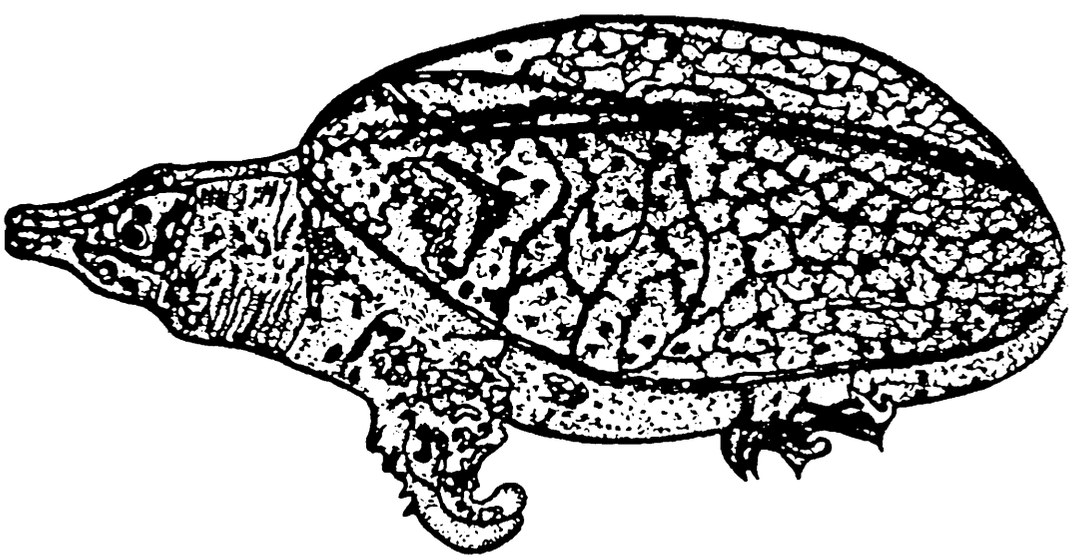

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Fig.158 Carapace of *Dogania subplana* (Geoffray)

Genus 23. *Trionyx* Geoffroy 1809

1809. *Trionys* (in part) Geoffroy, *Ann. Mus. Hist. Nat. Paris*, 14 : 4 & 20 (type *Trionyx aegyptiacus*).

1890. *Trionyx* Boulenger, *Fauna Brit. Ind.* 10.

1931. *Trionyx* Smith, *Fauna Brit. Ind.* 1 : 166.

Main generic characters are : Normally eight pairs of costal plates are present; outer extremity of nuchal plate overlying the second dorsal rib; normally eight neural plates; eight dorsal plates; the last one or two are in contact in the middle line. Hyoplastron is distinct from hypoplastron; not more than five plastral callosities are present in the adult. Skull is convex dorsally; postorbital arch narrower than the orbital diameter; posterior margin of ptergoid is free, without an ascending process. Limbs exposed, with three claws. Tail short. Proboscis about as long as the opening of the eye. Dorsal disc of the young are with small tubercles mostly arranged in longitudinal series. Out of 15 species available in the whole, ten are Asiatic, one African and four American. In Indian Region six species are present.

Key to the species

1. Two neural shields separate the first pair of costal shields of carapace.
   a. Alveolar surface of mandible raised at its inner margin, the edges meeting and forming a projection at the symphysis, the length of which is less than the diameter of the orbit in the adult; maxillary groove is well defined; head with black streaks; disc of young without ocelli .....*T. gangeticus*
   b. Alveolar surface of mandible not raised at its inner length margin; a longitudinal ridge at the symphysis, the length of which is equal to the diameter of the orbit; maxillary groove is prominent; head blackish .....*T nigricans*
   c. Alveolar surface of mandiable not raised at the inner margin, more or less flat at the symphysis, which is usually longer than the orbital diameter in the adult; maxillary groove well defined; head with black streaks, disc of young with 4 or more ocelli .....*T. leithi*
   d. Alveolar surface of mandible not raised at the inner margin, grooved at the symphysis, which is distinctly longer than the diameter of the orbit in the adult; maxillary groove ill defined; head marbled with black and yellow; disc of young with 4 or more ocelli ..... *T hurum*
3. Only one neural shield separate the first pair of costal shields of carapace; a longitudinal symphysial ridge is present on the alveolar surface of the mandible.
   a. Snout not longer than the diameter of the orbit; epiplastra widely separated from one another; carapace in young with large paired ocellar spots .....*T formosus*
   b. Snout longer than the diameter of the orbit; epiplastra are either in contact with one another or narrowly apart; carapace in young with black, scattered spots .....*T cartilageneus*

INDIAN SOFT-SHELLED TURTLE
OR
GANGA SOFT-SHELLED TURTLE

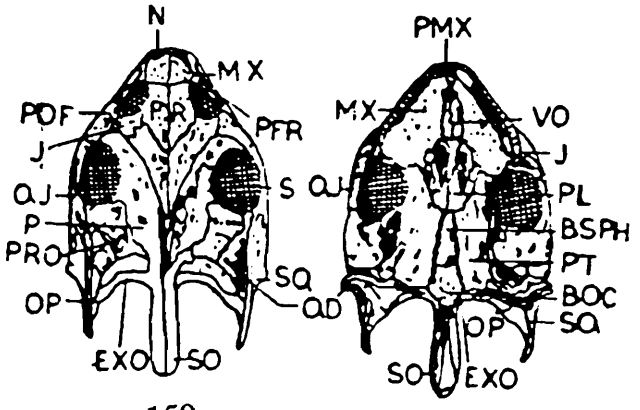
38. *Trionyx gangeticus* (Cuvier 1825)
(Figs. 159 – 162)

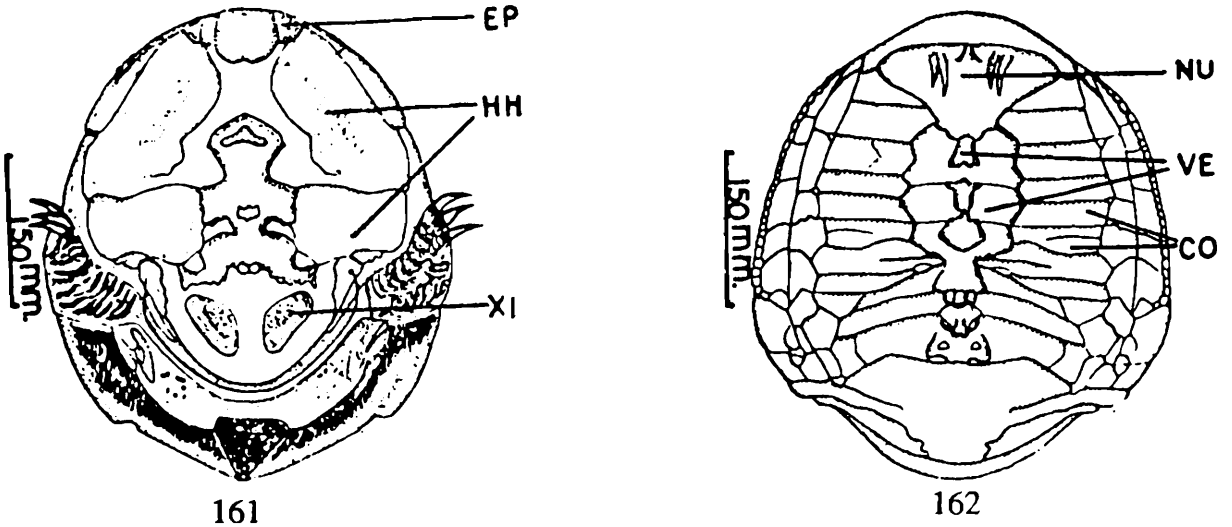
1824. *Trionyx gangeticus*, Cuvier, Oss. Foss. 5 : 186, 203, 206, pls. 11 & 12 (type loc. Ganges : Paris Mus. Nat. Hist.).

1890. *Trionyx gangeticus* Boulenger, *Fauna Brit. Ind.* 12.

1931. *Trionyx gangeticus* Smith, *Fauna Brit. Ind.* 1 : 167.

This is a very large, soft-shelled turtle with an oval shell and reaches up to 45 cm. in length. The head is comparatively large and broad with dorso-laterally situated eyes and quite thick and somewhat elongated proboscis. The snout is equal to the diameter of the orbit. In the skull (Figs. 159 & 160) postorbital arch is one-half to one-third the diameter of the orbit; alveolar surface of upper jaw is flat, with a well defined medial axillary groove between them; mandibles with raised inner edges, which meet at the symphysis to form a short, median projection; length of symphysis





Figs.159–162. *Trionyx gangeticus* Cuvier. 159. Skull (Dorsal); 160. Skull (Ventral). 161. Carapace; 162. Plastron.

is less than the diameter of the orbit in the adult. Two neural plates rest between the first pair of well developed costal plates; last pair of costal plates is generally in contact in the mid-line; all the plates of the carapace (Fig 161) are coarsely pitted and vermiculated; Nuchal shield is not present; limbs of epiplastra long and slender, in contact with or narrowly separated from one another; four plastral callosites, hyo- hypoplastral and xiphiplastral are well developed in the fully adults, in aged turtles a fifth callosity is also present upon the entoplastron (Fig. 162). Limbs are with three claws. Tail is short in both sexes. Dorsal colouration is olive-green; carapace is dull olive or greenish with irregular dark reticulations; plastron is ivory white; head is greenish, with a black longitudinal streak from between the eyes on the nape and three oblique black streaks on either side diverging from it; another streak starting from behind the eye. Juveniles are greenish with a reticulated pattern of four irregular ocelli on the carapace; sometimes with black longitudinal line on the top of the head.

Distribution : India : Ganga, Sind and Mahanadi river systems. Elsewhere : N.W. Pakistan, Bangladesh and the Nepal foothills.

Habits and habitat : The species is highly aquatic inhabiting the deep turbid rivers but it is frequently seen basking on sandy banks or resting in shallow water with its head stricking out of water. It is an omnivorous species and the diet comprises a wide range of aquatic vegetarian and animal food like fish, molluscs, frogs and crustaceans. It is a very prominent scavenger also. Breeding takes place in late September to October. The spherical and hard shelled eggs with a diameter of 3 cm. are laid on the sandy river banks.

Status : The species has become endangered on account of excessive killing of the adults for flesh, and overexploitation of eggs for food. The flesh of this turtle is highly liked as an important food item at various places in Bengal and Orissa. Habitat destruction is also a principal factor of threat to this species.

Conservation : Nominally protected by legislation but adequate measures are not followed strictly. Exact data on the population are not available but the number has reduced drastically. A detailed study on the status and ecology will lead so as to formulate suitable management plans to conserve this endangered species. This turtle species has already been included in the Appendix I of IUCN.

39. ***Trionyx nigricans*** Anderson 1875

1875. *Trionyx nigricans* Anderson, *An.. Mag. Nat. Hist.* **16** (4) : 284 (type loc. Chittagong Tanks; Ind. Mus.).

1931. *Trionyx nigricans* Smith, *Fauna Brit. Ind.* 1 : 168.

It is a very large turtle, whose length sometimes exceeds 80 cm. The structure and other taxonomic characters of head, limbs, carapace and plastron are like that of *Trionyx gangeticus* except that the snout longer than the diameter of the orbit; postorbital arch one half or less the diameter of the orbit; alveolar surface of upper jaw is flat, with a well defined maxillary groove between them, inner edge of mandiable not raised; symphysis with a prominent longitudinal ridge; length of symphysis about equal to the orbital diameter in the adult. The dorsal colouration is dark olive

or copper brown, indistinctly marbled with a darker shade. Plastron is of lighter colour, densely spotted with blackish purple. Head in adult individuals is blackish intermixed with greenish spots or with a greenish tinge is very old turtles, under side of head and neck is blackish; dorsal aspect of the limbs is black, claws are yellow.

Distribution : Bangladesh (Chittagong). A semi-wild population inhabiting a large muddy bottomed tank, near the mohommedan shrine of Sultan Bagu Bastan nearly 8 km. from Chittagong.

Habits and habitat : Annadale states that turtles were so tame that they would come to feed when called. Otherwise they spend the day time half burried in the mud at the bottom of the pond, while nights are spent out of the water on a small hill. Oviposition took place in a rainy weather, the eggs being laid in the same hill. This semi-captive population of *Trionyx nigricans* is still flourishing in the same tank.

Status : Vulnerable, but well protected.

PENINSULAR SOFT-SHELLED TURTLE
40. *Trionyx leithi* Gray 1872
(Figs. 163 & 164)

1872. *Trionyx leithi*, Gray, *Ann. Mag. Nat. Hist.* 10(4) : 334 (type loc. Poona; Brit. Mus.).

1890. *Trionyx leithi*, Boulenger, *Fauna Brit. Ind.* 12.

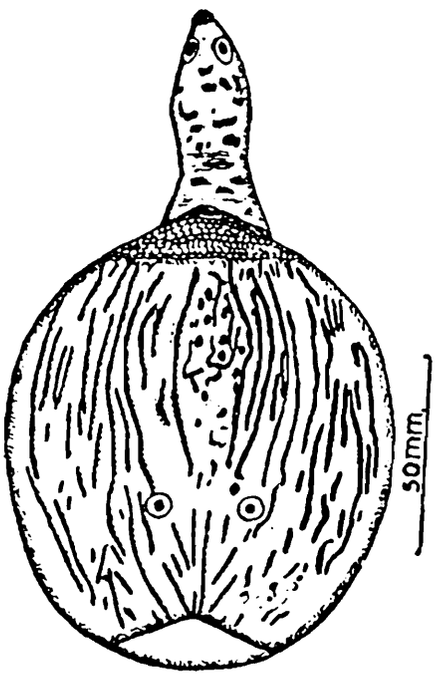
1931. *Trionyx leithi* Smith, *Fauna Brit. Ind.* 1 : 169.

This very large, soft-shelled turtle reaches slightly above 50 cm. in length. This species is quite similar to *Trionyx gangeticus* in the taxonomic characters of the carapace (Fig. 163) and plastron (Fig. 164) but differs from it in having a bony snout longer than the diameter of the orbit; postorbital arch one-half to one-third the diameter of the orbit; alveolar surface of upper jaw is flat and with a fairly well defined median maxillary groove between them; inner edge of mandible not raised; the mandibular symphysis is flat, its length is equal to or greater than the diameter of the orbit in the adult. Dorsal colouration is olive-green with lighter vermiculation. Ventrum is whitish. Head is greenish with black longitudinal lines from between the eyes and two or three oblique black streaks emerge on either side and one streak behind the eye. The carapace in the juveniles is with four distinct ocelli (concentric circles).

Distribution : India : Ganga river systems and all the rivers of Peninsular India as far south as Madras.

Habits and habitat : The species is perfectly aquatic and like *Trionyx gangeticus* is frequently seen basking on sandy banks or resting in shallow water with its head sticking out of water. The species inhabits deep turbid rivers as well as canals, marshes, ponds and lakes. The species is completely omnivorous like *Trionyx gangeticus* and is also a scavenger. Eggs are slightly oval.

Status : This species is also endangered on account of excessive killing of the adults for flesh, and overexploitation of eggs for food. Habitat destruction and urbanisation is another factor responsible for its decline.



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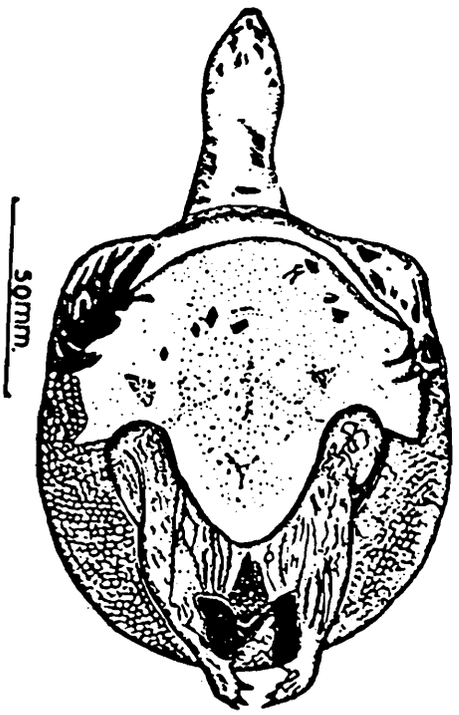

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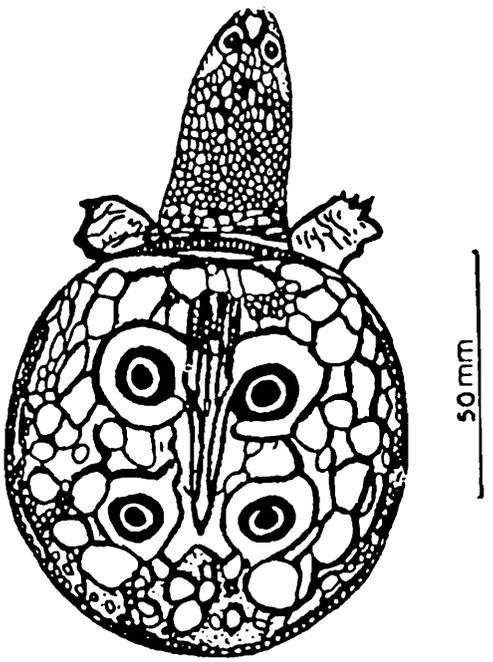
Figs. 163 &164. *Trionyx leithi* Gray. 163. Carapace; 164. Plastron.



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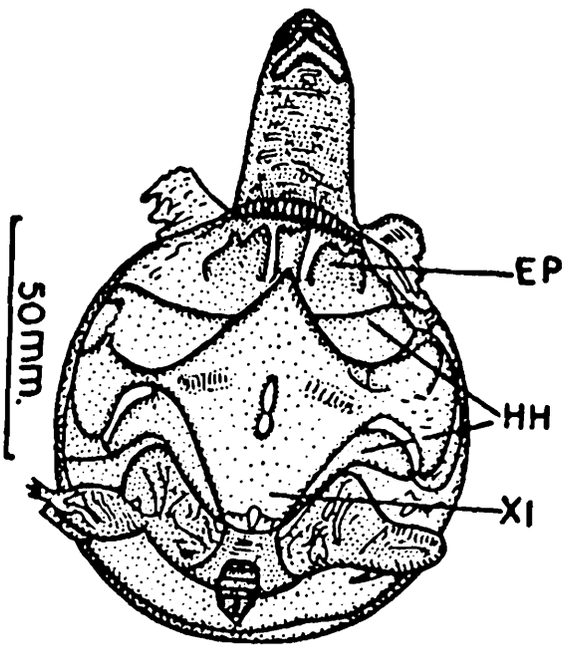

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Figs. 165 & 166. *Trionyx hurum* (Gray). 165. Carapace; 166. Plastron.

PEACOCK-MARKED SOFT-SHELLED TURTLE
41. *Trionyx hurum* Gray 1831
(Figs. 165 & 166)

1831. *Trionyx hurum* Gray, *Syn. Rept.* 47, pl. 10, based on Hamilton's drawing in *Brit. Mus.* (type loc. Fathegarh, Ganges).

1890. *Trionyx hurum*, Boulenger, *Fauna Brit. Ind.* 49, fig.

1931. *Trionyx hurum*, Smith, *Fauna Brit. Ind.* 1 : 170.

This is a gigantic soft-shelled species in which length reaches up to 60 cm. and above. The head is comparatively large and its snout is prominently projecting down turned and is longer than the diameter of the orbit; postorbital arch one-half to one-third the diameter of the orbit; alveolar surfaces of upper jaw sloping gradually to meet the median maxillary groove; mandibular symphysis has a median groove which is longer than the orbital diameter. Other taxonomic characters of carapace (Fig. 165) and plastron (Fig. 166) are as available in *Trionyx gangeticus*. Dorsum is olive-green, reticulated with black and generally with four striking ocelli (like the peacock eye) with a narrow yellow rim and large number of broken longitudinal markings. Head is dark green with several yellow spots. Carapace ocelli and yellow head spots become less distinct with the advancement of age. A pale yellow spot across the snout is always present. Plastron is ivory-white.

Distribution : India : Lower reaches of the Ganga and Brahmaputra rivers.

Habits and habitat : The species is markedly aquatic and omnivorous.

Status : The species has become endangered on account of habitat loss and by the predation of man and animals for food.

Conservation : Nominally protected by legislation but adequate measures are not followed strictly.

42. *Trionyx formosus* Gray 1869.

1869. *Trionyx formosus*, Gray, *Proc. Zool. Soc.* 217, pl. 15 (type loc. Pegu; Brit. Mus.).

1890. *Trionyx formosus*, Boulenger, *Fauna Brit. Ind.* : 14.

1931. *Trionyx formosus* Smith, *Fauna Brit. Ind.* 1 : 171.

This is a moderately large Burmese soft-shelled turtle whose carapace length in few individuals exceeds 43 cm. The snout is equal to or slightly less than the diameter of the orbit; postorbital arch one-half to one-third the diameter of the orbit; alveolar surface of the mandible is with a longitudinal ridge at the symphysis. This species differs from other soft shell by not having a preneural bone (a laterally expanded bone situated between the nuchal and the first neural, between the anterior halves of the first pleural bones, in most soft shells). Only one neural shield is present, which is situated between the first pair of costals; costal plates are well developed, the last pair remains in contact in the mid-line; all the plates are well developed, the last pair remains in contact in the mid-line; all the plates of the carapace pitted and vermiculated; anterior limbs of epiplastra are moderately long and slender, separated from one another; there are four well developed plastral callosites, hyo-hypoplastral and xiphiplastral in the adult

turtles. Dorsal colouration in the juveniles is dark olive-grey, with black reticulations and two pairs of large black-central ocelli; Ventrl aspect is greyish. Head in the young turtles is yellowish with yellowish dark-edged spots, an elongated one on either side at the back of the head and smaller ones on the temple, at the angle of the mouth, and on the chin. In adults such markings are not available, the head is yellow with black reticulations or punctate markings above and on the sides. Carapace in the adults is profusely spotted with black and with four large, rounded, obscure black areas.

Distribution : Burma (Irrawaddy, Sittang and Salween river systems), southern China (Burma-chinese frontier, Yunnan Province).

Habits and habitat : Not much is known about the habits but is extremely aquatic, carnivorous and pugnaceous in wild state. But it becomes perfectly tame in captivity and feed on chicken and rice. Certain Muslims in Burma regard these turtles as sacred animals and protect them in the muddy ponds in certain Muslim shrines near Mandalay.

Status : Wild population are not known, but species is certainly eaten by some people in Burma and live turtles are rarely seen. The species is suspected to be threatened in a major area of its range.

BLACK-RAYED SOFT-SHELL TURTLE

43. ***Trionyx cartilagineus*** Boddaert 1770

(Fig. 167)

1770. *Testudo cartilaginea*, Boddaert, *Epistola ad W. Roell, cum Tab.*

1890. *Trionyx cartilageneus*, Boulenger, *Fauna Brit. Ind.* 15.

1931. *Trionyx cartilageneus*, Smith, *Fauna Brit. Ind.* 1 : 172

This is a very large turtle whose carapace length in few individuals reach up to 82 cm. Snout is bony and longer than the diameter of the orbit; it is comparatively longer in the juveniles than the adults; preneural bone is not present; post-orbital arch is one-half to one-third the diameter of the orbit, alveolar surface of mandible with a longitudinal ridge at the symphysis. Carapace and plastron is like that of *Trionyx formosus*, except that the epiplastra are in contact with or narrowly separated from one another and the plastral callosites sometimes poorly developed, even in the adult. The carapace in juveniles is olive-green, with broad black radiating streaks, the entire surface is densely spotted with yellow and with one or two irregular black spots outlined in yellow. In the adults the spots are not availabe on the carapace, which is uniformly olive-green. Head in the young with yellow spots the largest of which are generally below and on the sides, in the adult the yellow spots on the top and sides of the head become less distinct, but the intervening spaces are darker, so that the final result is a black reticulation upon an olive-ground; the chin and neck below become whitish or greyish. The plastron is white in the male, grey in the female. In some individuals the top of head is with black streaks, which may assume the shape of X.

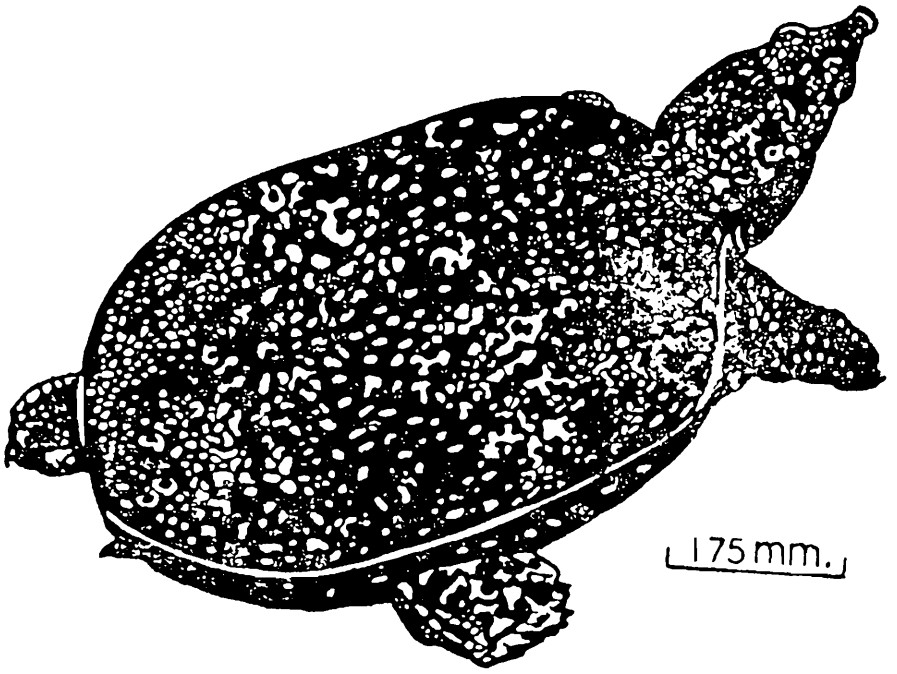

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Fig. 167 A view of *Trioniyx cartilagineus.* (Boddaert).

Distribution : Southern Burma, Thailand, southern Laos, Cambodia, north and south Vietnam as far north as the Gulf of Tonkin, Malaysia, Java, Sumatra and Borneo.

Habits and habitat : It is a carnivorous species and its diet comprises, mainly the fishes, crustaceans and amphibians; inhabits muddy slow-flowing river and hill streams. Deposits its eggs 930x40 mm.) in holes in muddy banks.

Status : Insufficiently known. Its flesh is not considered much suitable for human consumption as the flesh is quite inferior in flavour.

ORDER CROCODILIA
(GHARIALS, CROCODILES, ALLIGATORS AND CAIMANS)

It has already been stated while discussing the phylogeny of crocodiles that these are the diapsid archosaurian reptiles, closely allied to the Dinosaurs. Now it has been established the primitive archosaurian thecondonts like *Euparkeria* from Permian and Triassic periods have given rise to the modern crocodilians. All the living species are amphibious and having a distribution in the warm tropical parts of the Earth. The Crocodiles of the Indian Region are the nearer relatives of living alligators on one side and of the fossil archosaurs on the other, which comprised a much diversified assemblage of repitle orders like Thecondontia, Saurischia, Ornithischia and Pterosauria, which ruled the land for 150 million years from the Triassic to the end of Cretaceous. Jurassic period was the golden age for crocodiles when they flourished in all the possible ways and reached to a

height of evolution in form, size and dispersal. The main characters of Crocodiles are as follows :

Skin : (Fig 168) The whole body is covered with a hard integument comprising the horny cutaneous scutes or scales, between which the skin is soft. These scales are arranged in regular transverse series and lie immediately above the strongly ossifed osteoderms on the dorsum, thus providing a strong dermal armour to the creature. The ecdysis is not available in crocodilia but the skin is shed after certain intervals in small parts.

Skull : (Figs. 169-176) The skull in Crocodilia is typically diapsid i.e. the termporal region is with two fossae, both th supra and infra temporal fossae are complete in the crocodiles of Indian Region. The infratemporal fossa is bordered by the jugal and quadratojugal bones on the ventral aspect. The quadrate bone is large and immovable and is united to the arches of the skull. Premaxilla partially or completely enclose the external nares, which are located at the extreme end of the snout. Maxillary and palatine bones meet at the mid-line of the palate and thus provide a large extended cover to the mouth and the internal nares are shifted far back. The secondary palate is extremely long, the internal nostrils open behind the pterygoids. A valve prevents the entry of water in the trachea when the jaws are open in submerged condition, while carrying the prey down in deep water. This valve is formed by the tissue emerging downward from the palate and upward from the rear of the tongue. Nostrils are paired dorsally situated on the snout, prominently located and valvular, which close at once when the crocodile is submerged. The shape, size and comparison of the supratemporal fossa with the orbits exhibit remarkable variations in different genera of crocodilians. In more primitive forms it was a large as, or even larger than, the orbit. This condition is still found in the family Gavialidae and it is certain that *Gavialis* is the most primitive of the living crocodilians. At the evolutionary point of view crocodilians can be divided into two categories i.e. long and narrow snouted form like *Gavialis* and a broad and short-snouted one like *Crocodylus*. The former condition is more primitive and the elongation of the snout is mainly on account of the prolongation of the maxillary bones anteriorly and on account of the formation of the secondary bony palate caused by the union of the maxillae, palatines and ptergoids in the mid- line of the roof of the mouth. The formation of this secondary bony palate has shifted the narel openings far at the back of the mouth. The extension of the large quadrate bone articulates or partially fuses with the quadrato-jugal, the squamosal, and the occipital bones. The intermandibular symphysis is most variable in length and the variation depends upon the length of the snout. This is why it is long in the Indian Gavial (Gharial) and short in the crocodiles. In crocodilia the mid-dorsal region of the skull is devoid of pineal or parietal eye or foramen and Jacobson's organ (is absent in the adult individuals). The auditory capsule in crocodilia is formed by tympanum, prootic and opisthotic. The external ear-drum is visible but the crocodiles are least sensitive to most sounds.

Vertebral column : The vertebral column consists of 66 procoelous vertebrae, 9 cervical, 15 dorsal and lumber, 2 sacral and upto 40 caudal vertebrae. The intervertebral articulation is by fibro-cartilaginous pads, the fusion of the vertebral elements is partial and most effectively exhibited in atlas-axis complex and the demarkation of the neural arch from the centrum is absolutely sutural. The vertebral central centra are platycoelous (flat-ended), amphicoelous (biconcave) or procoelous (concave in front and convex behind). The side movements of the trunk of crocodilians are most restricted and the maximum movement is available at the base of the tail where the centrum of the first caudal vertebrae is amphicoelus. Almost all the caudal vertebrae are with the Y-shaped outgrowths of the intercenta projecting downwards from the ventral aspect of the vertebrae. These structures are known as chevron bones.

Sternum : The sternum in crocodilia is cartilaginous and articulates with the coracoids, 7-8 pairs of ribs and inter clavicle remains wedged at its antero-dorsal aspect. Sternum bifurcates on its posterior aspect, each half bearing two or three ribs.

Ribs : The ribs are double headed and both the heads distinctly articulate with most of the vertebrae (but the position of the heads is not uniform in respect to one another and to the vertebrae). The 5 or 6 ribs in the lumber region are stout and firmly united with the vertebrae in the adult crocodilians. Seven or eight pairs of ribs unite with the sternum and are called as the sternal ribs. The abdominal region of the crocodilia is devoid of true ribs and the space between the posterior end of the sternum and the pubis is occupied by certain structures called as gastralia (false ribs or abdominal ribs), formed by the ossifications of the fibrous tissue which develops between the skin and the muscles. False ribs are also available in Sphenodon, Chameleons and the Geckoes.

Pelvic Girdle : The another most significant structure in crocodilian skeleton is its pelvic girdle. In the adult crocodiles the pelvis is formed by the union of three separate bones. Ilium on side unites with the ischium and takes a major role in the formation of the acetabulam, while on the upper aspect it unites firmly with the sacral ribs. The pubis remains loosely attached to the ischium and the mid-line interarticulation of its two halves is absolutely cartilagenous. Pubis has no participation in the formation of the acetabulum fossa which provides a deep socket like articulation to the head of femur.

Teeth : The teeth in crocodiles are conical, restricted to the jaws; set in separate, deep, alveolar sockets and are replaced many times in the life.

Digestive System : The additional space is provided in the crocodilia to the small stomach for food storage by the presence of a large gullet. Large quantity of food can be stored in a gullet when the digestion is in the progress in the stomach.

Key to the families

1. Snout very long and slender; at least three times longer than its basal width; 27-29 teeth on each side of the maxilla; 25-30 teeth on each side of the mandible; the lower teeth interdigitating with the upper teeth and do not fit into pits or notches in the upper jaw; the supratemporal fossae are large; two rows of scutes on the back and no scutes on the belly.....GAVIALIDAE...2

2. Snout not very long and slender; not more than two times longer than its basal width; 16-19 teeth on each side of the maxilla; 14-15 teeth on each side of the mandible; the lower teeth interlocking with the upper teeth and fit into pits or notches in the upper jaw; the supratemporal fossae are small; two or more rows of scutes on the back and no scutes on the belly ..... CROCODYLIDAE

Family I. GAVIALIDAE Huxley 1859

1859. Gavialidae Huxley, *On the dermal armour. J. Linn. Soc.* 4 : 1-28.

The posterior region of the skull gradually becomes sharper and turns in a long slender snout; maxillae articulate dorsally by a prominent suture, thus not permitting nasals to meet the premaxillae, nasals are dorsally wedged in between the maxillae anteriorly and lachrymals posteriorly; pterygoids participate in the formation of the secondary palate which is completely bony, pterygoids meet in the mid-line of the palate and enclose the posterior nares completely; vertebral column is made up of procoelous vertebrae, cervical vertebrae possess ventral keels; clavicles are not present; sternum is cartilaginous; the supratemporal fossae of the skull are large but orbit is devoid of the sclerotic plates; the dorsal armous is well developed and is provided with two longitudinal rows of horny scutes on the dorsum but such scutes are not available on the belly; the mandular symphysis is very long and prominent. five Man is with us digits but pes is with four, only the three inner digits are clawed. Anal opening is longitudinal and penis is unpaired.

Genus I. *Gavialis* Oppel 1811

1811. *Gavialis* Oppel, *Ordn. Rept.* 19 (type *Crocodilus gengeticus* Cuvier)

1931. *Gavialis*, Smith, *Fauna Brit. Ind.* 37.

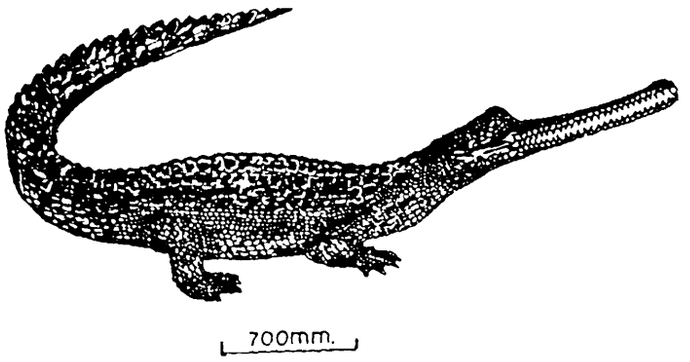
Snout is narrow, much elongated and dilated at the end (Figs. 168-173) premaxillaries widely separated from the nasals which are short, paired bones, wedged between the lachrymals and maxillaries. Maxillary teeth 27-29; mandibular teeth 25 or 26; teeth on the anterior portion of jaws are largest, others are almost equal in size; the first, second and third mandibular teeth fit in to pits in the upper jaw. Anterior portion of the orbits is most prominent and slightly bulged. Mandibular symphysis reaches up to 23rd or 24th tooth. The genus is monotypic.

1. *Gavialis gangeticus* (Gmelin 1789)
(Figs. 168–173)

1789. *Lacerta gangetica* Gmelin, Syst. Nat. 1057.

1931. *Gavialis gangeticus* Smith, *Fauna Brit. Ind.* 39.

A distinctively large, extremely slender snouted, fish eating, amphibous gavialid crocodilain, in which adult males reach to a maximum around 6.5 m. and females about 4.5 m. This is the oldest of the living crocodilia and its ancestory can be traced back in India up to Pilocene of the Siwalik Hills and Narbada valley, when its ancestors were the strong rulers of the scene and one of them, *Rhamphosuchus crasidens* was a gigantic crocodilian reaching to a length up to 23 metres. Snout in the adult



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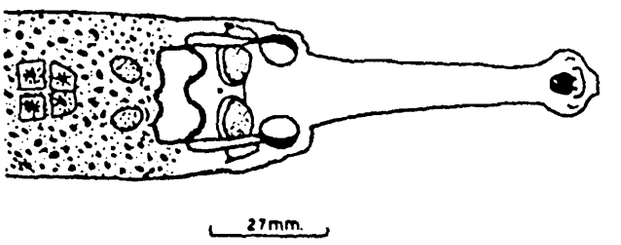

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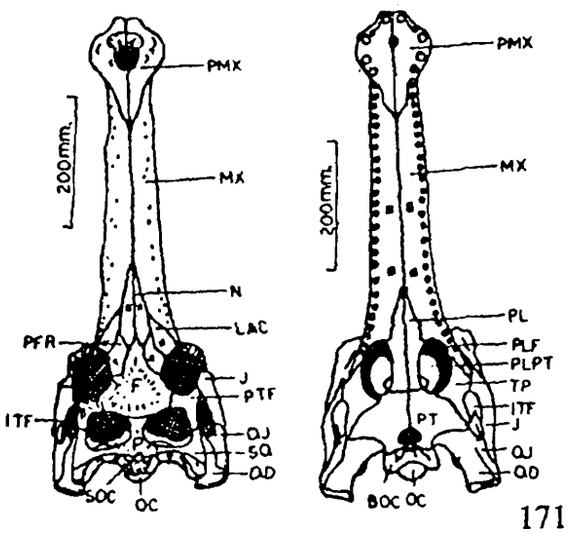

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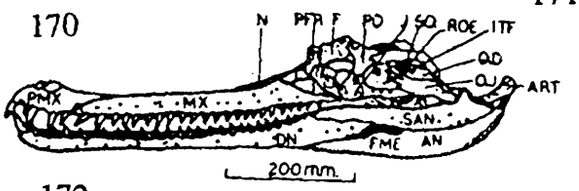

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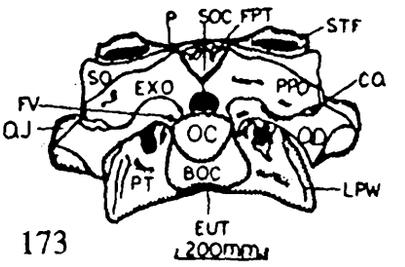

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Fig.168. *Gavialis gangeticus* (Gmelin).

Figs. 169–173. *Gavialis gangeticus* (Gmelin). 169. Head; 170. Skull (Dorsal); 171. Skull (Ventral); 172. Skull (Lateral); 173. Skull (Occipital region).

individuals is almost $3^1/_3$ times longer than its basal width but in the juveniles sometimes this proportion is about $5^1/_2$ times. Body strongly armoured, nuchal and dorsal scutes form a regular series and are in 21 or 22 transverse rows, sometimes the outer most rows are indicated by less prominent scutes or keels; two small post-occipital scutes are also available. Fingers and toes are partially webbed (median finger one third, outer fingers two-third webbed). Outer aspect of the limbs are with strongly serrateed fringes. Each side of jaw bears more than two dozen sharp pointed teeth. Adult male Gharial bear a tough bulbous excrescence at the tip of the snout. The name Gharial is derived from the resemblance of the knob to an earthern pot, known as a 'ghara' in north India. When the male emerges from water the obstruction of exhaled air caused by the ghara usually results in a hissing sound. Adults are olive, young are with lighter colour, spotted or barred with dark brown.

Distribution : Now a days present in Bangladesh, India, Nepal and Pakistan. Mainly restricted to the Himalaya-fed river system in the north of the Indian subcontinent, namely the Sind, Ganga and Brahmaputra Rivers and their tributaries. Further south Gharial is available in the Mahanadi River. Formerly present in the Manas River (a tributary of Brahmatputra) in Bhutan.

Habits and habitat : Gharial prefers to live in deep fast-flowing sinous river with relatively clean water, high banks, deep pools and undisturbed sand banks at the river edge or in mid-river for nesting and basking. Gharials bask on sand banks for long periods during the winter, when water levels are low. Dispersal especially of juveniles, often occurs during monsoon flooding when Gharials move out of the mainstream into side creeks. Like other crocodilians, Gharial will float at the water surface with only the eyes and tip of the snout exposed. Gharial feeds mainly on fish. A swimming fish is first seized across the middle, then the long snout is raised out of the water and with two or three snaps of jaws the entire fish is turned and swallowed head first. Occasionally they supplement their fish diet by birds, dogs and other vertebrates. Sometimes they attack on human beings also. Nesting takes place from late March to mid- April in sand banks on the river-edge, or in mid river. Between 18-40, elliptical eggs (85-90 mm. long and 65-70 mm. wide) are laid in quite deep nests. The inside temperature of the nest ranges between 25-37°C and inside humidity also remains relatively constant despite periods of rainfall. Incubation period ranges between 83-94 days. The female guards the nest site and also closely attends the hatchlings for several months. Sometimes the mother Gharial stays for months together in the shallow water with hatchlings on her head and body, and others swmiming or basking on the bank immediately beside her. Sexual maturity is attained at between 8-12 years, at a length of about 3 metres.

Status : At present the status of Gharial is critically depleted. Such a serious plight is mainly attributed to habitat modification and disturbance and to killing of animals for skins or in course of fishing operations. ii. A secondary factor is collection of eggs for food by some tribals. iii. Both eggs and hatchlings are heavily predated by fish, jackals, monitor lizards, birds of prey and larger Gharials. iv. A significant number of nests are destroyed by flooding.

In the nineteenth and early twentieth centuries the Gharial was in abundance

in many areas, but now extinct or extremely depleted throughout its former range. It is almost extinct in Bangladesh and Pakistan, less than 20 individuals may be present in each country. The estimated Indian population was not more than 75 animals in 1970 and the species was almost at the verge of extinction. But recently implemented conservation measures give some hope for the survival of this crocodile in India. Now the approximate number of Gharials in India is 141 individuals (including the juveniles) distributed in major rivers in the states of Uttar Pradesh, Rajasthan and Madhya Pradesh. In other parts of India it has been estimated that less than 10 occur in Orissa, less than 10 in Bihar and around 10 in Assam. Few isolated Gharials still available in some Indian rivers that formerly supported large populations, such as the Ramganga in Corbett National Park (U.P.), the Gharga (U.P.), the Gandak (U.P. and Bihar) and the Kosi (Bihar). The regular breeding of Gharial has been known in recent years is only three areas, in the Girwa, Chambal and Mahanadi Rivers. The Government of India initiated a crocodile breeding and management project in 1975, with preliminary survey being undertaken in 1974. This project operates on advice from a U.N. Food and Agriculture Organisation (F.A.O.) Chief Technical Advisor, with finance from the U.N. Development Programme (UNDP). Under this scheme, Gharial eggs are collected from the wild, transported to hatcheries where the young are reared for release into the wild at a length of 1.2 m., aged about 18 months. These Gharials hatcheries are located at various places in India as namely Tikarpada, Mahanadi River (Orissa); Kukrail near Lucknow (Uttar Pradesh); Satkoshia Gorge Sanctuary (Orissa); National Chambal River Sanctuary (Uttar Pradesh; Madhya Pradesh and Rajasthan) and Katerniaghat Sanctuary, Girwa River (Uttar Pradesh). Breeding in captivity occured for the first time at the Nandankannan Biological Park in Orissa, where a female mated with a male and and laid 25 eggs in March 1980, from which 24 hatchlings emerged on 7 May, 1980.

Family II. CROCODYLIDAE Gray 1825

1825. Crocodylidae Gray *Ann. Phil.* (2) x. 195.

The posterior region of the skull is not ending into sharply set off snout; nasals are in contact with the premaxillae and extend to meet the external nares; pterygoids participate in the formation of the secondary palate, which is completely bony, pterygoids meet in the mid-line of the palate and enclose the posterior nares completely; vertebrae are procoelous, cervical vertebrae bear ventral keels; clavicles are missing; sternum is cartilaginous; the supratemporal fossae of the skull are small; oribt is devoid of scelrotic plates; the dermal armour is well developed and is provided with 4 to 8 longitudinal rows of horny scutes on the dorsum, such scutes are not found on the belly; the mandibular symphysis is moderately long and prominent. Manus is with five digits but pes is with four, only the three inner digits are clawed. Anal opening is longitudinal and penis is unpaired.

Genus 2. *Crocodylus* Gronovius 1763

1763. *Crocodylus*, Gronovius, *Zoophyl. fasc. i.* 10.

1890. *Crocodylus*, Boulenger, *Fauna Brit. Ind.* 4.

1931. *Crocodylus* Smith, *Fauna Brit. Ind.* 40.

Snout moderately broad, not much elongated, not dilated at the end which premaxillaries are in contact with the elongated nasals extend up to the nasal opening. Maxillary teeth 16-19 and mandibular teeth 14 or 15 on each side; fourth or fifth maxillary tooth is largest; fourth mandibular tooth fits into a notch in the upper jaw. Splenial bones does not touch the mandibular symphysis and never extend beyond the fourth or fifth mandibular tooth. The dorsal armour is formed of from 4 to 8 longitudinal series of keeled bony scutes. The genus has ten species in the world out of wich two are available in the Indian Region.

Key to the species

1. Each premaxilla in adult possess 4 teeth; suture between the premaxillae and maxillae is W-shaped; a strong dorsolateral ridge emerges from the anterior aspect of the orbit (eye) and extends almost up to half the length of the snout, which is $1^2/_3$ to $2^1/_6$ times as long as broad at the base; bony portions of the dorsal scutes separated from each other by soft skin; post- occipital scutes are not present ..... *Crocodylus porosus*
2. Each premaxilla in adult possess 5 teeth; suture between the premaxillae and maxillae is almost straight; dorsolateral ridge in front of the eye is rarely available in some individuals but extend anteriorly or a short distance on the snout; snout is $1^1/_3$ to $1^1/_2$ times as long as broad at the base; bony portions of the dorsal scutes in contact with one another in a transverse series ..... *Crocodylus palustris*

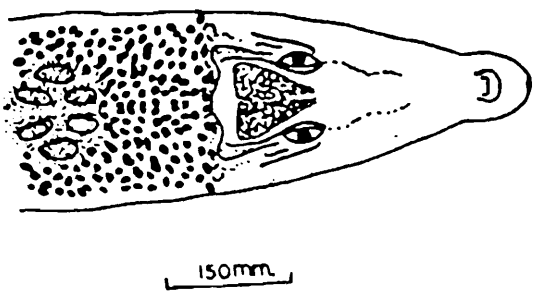
2. *Crocodylus porosus* Schneider 1801
(Figs. 174 & 175)

1801. *Crocodylus porosus*, Schneider, *Hist. Amphib. ii.* 159.

1890. *Crocodylus porosus* Boulenger, *Fauna Brit. Ind.* 4.

1931. *Crocodylus porosus* Smith, *Fauna Brit. Ind.* 42.

The largest and strongly built of all existing crocodilians (maximum recorded length around 10 m., a few individuals of 7-8 m. still occur in India). Body shielded by an overall armature of closely set, horn-sheathed, bony plates with saw-toothed fringes along the upper border on tail Snout (Fig. 174) in the adult individuals is almost $1^2/_3$ to $2^1/_6$ times longer than its basal width and bears prominent ridge on each side radiating from the anterior margin of the eye, both the ridges converge towards each other at the middle of the snout. Body strongly armoured; four large nuchal scutes from a square like pattern; one small scute is also present on each pointed or angular margin of the nuchal region; in few individuals two small occipital shields are also present, dorsal scutes in 16 or 17 transverse and 4 to 8 longitudinal series; the bony portions of the dorsal scutes are well apart from one another in the adults and similar but irreguarly situated scutes are present on the sides. Fingers are webbed at the base; outer two toes are webbed to the end of the digits; in two middle toes the webbing is not up to the end of the digit and inner toes are half webbed. Outer aspects of the limbs bear serrated fringes. Jaws bear formidable pivoted



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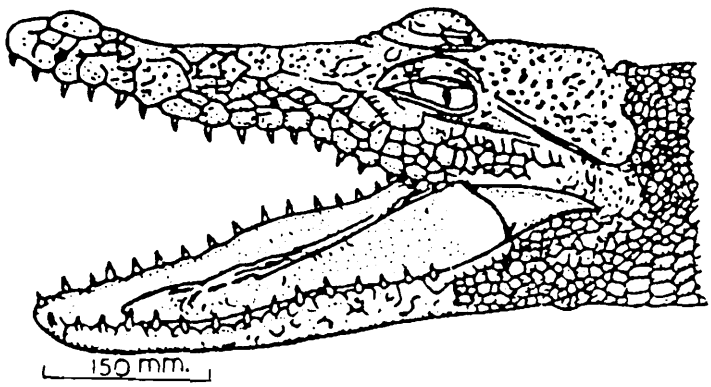

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Figs. 174 & 175. *Crocodylus porosus* Schneider. 174. Head (Dorsal); 175. Head (Lateral).

teeth (Fig. 175); 17 to 19 on each side which remain exposed even when mouth is closed; (4 in each pre-maxilla); suture between the premaxillae and maxillae is W-shaped; enlarged fourth tooth of the lower jaw fits into a notch on the side of the upper jaw. Adult crocodiles are dark olive and young are paler with large black spots.

Distribution : *Crocodylus porosus* has a wide range of distribution and is available in Sri Lanka, the east cost of India, the Andaman and Nicobar Islands, Bangladesh, Burma, Thailand, Kampuchea, Vietnam, the Philippines, the western Carline Islands (Palau Group), Malaysia, Indonesia, Brunei to Papua New Guinea, the Solomon Islands, Vanuatu and northern Australia. Formerly was available near Cochin in Indian, southern China and Singapore but now it is extinct at these places. Wandering individuals have been noticed at sea and places far outside their range, such as Solomon Islands and Fiji Islands, Cocos-keeling and Ponape in the eastern Caroline Islands.

Habits and habitat : A sluggish and lethargic creature typically associated with brackish waters, such as coastal mangrove swamp-forests, but also visits fresh-water rivers and grass swamps. This crocodile is very well adapted to semiaquatic mode of life; enters the sea to make long oceanic journeys but inhabits estuaries. Appears like a dead log on land lying in wait for the quarry which are generally small domestic animals; in water it is an expert fisher. Although lives in saline water it drinks freshwater, *C. porosus* is an opportunistic feeder, and the nature and size of the prey taken varies with age and habitat. Feeding occurs during the day and night, when food is available, and on both ebb and flood tides in tidal regions. These crocodiles are mainly shallow water or edge feeders. Juveniles and sub-adults eat mainly crustacea, insects and small fish. Adults take an increasing proportion of vertebrae diet like sharks, archer fish, barramundi, pop-eye mullet, mullet, mudskippers, mangrove snakes, cormorants, magpie, geese, turtles, cattle, horses, flying foxes, monkeys and humans. Larger crocodiles are cannibalistic and take *porosus* hatchling and small

juveniles. Sexual maturity in males is attained in 16 years (3.2 m. length) and in female in 10 years (2.2 m length). *Crocodylus porosus* makes a mound like nest in the wet season and lays between 25-120 eggs. The incubation period is between 80-100 days. The female remains near to nest and defends it most carefully. She assists hatchlings to leave the nest and carry them to water and remains near them for a considerable period.

Status : This crocodile is threatened throghout the world on account of extensive hide-hunting and habitat destruction. Lack of osteoderms is the belly skin, small scutes and large size, lead to high demand for hides. The commercial value of its leather is the main reason of its over exploitation and as a result this crocodile has become quite rare in the coastal regions of South India. Remnants are now confined to the estuaries of the Sundarban, Mahanadi and coastal region of West Bengal, Orissa, Andaman and Nicobar Islands. The total Indian population of *porosus* may be between 170-330. Several breeding centres in Andhra Pradesh, Tamil Nadu, Orissa and West Bengal are successfully rearing this species. This crocodile breeds readily in captivity.

3. *Crocodylus palustris* Lesson 1834
(Figs. 176-179)

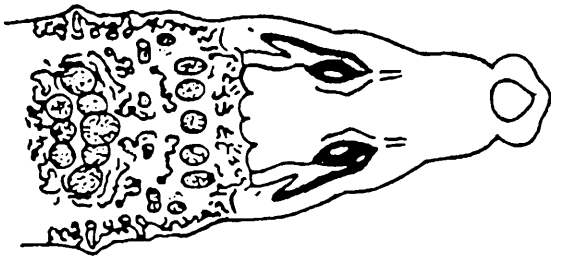
1834. *Crocodylus palustris* Lesson, in Belang, *Vou. Ind. or., Zool* 305. (type loc. Ganges).

1890. *Crocodylus palustris* Boulenger, *Fauna Brit. Ind.* 5.

1931. *Crocodylus palustris* Smith, *Fauna Brit. Ind.* 47.

A moderately large 3 to 5 metres in length, short and broad snouted, commonest of all crocodilians and the Gharial. Snout (Fig. 176) in adult individuals is almost 1 1/3 to 1 1/2 times longer than its basal width and is generally devoid of ridges in front of the eyes (if at all such a structure is present, it extends only for a short distance). Body strongly armoured; four large nuchal scutes form a square like pattern; one small scute is also present on each angular margin of the nuchal region, two pairs of post-occipital scutes are present in a transverse series; dorsal scutes are in 16 or 17 transverse and 4 to 6 longitudinal series; the bony portions of the dorsal scutes remain in contact with one another in the transverse series; similar but comparatively smaller scutes are irregularly situated on the sides. All fingers are webbed at the base; outer two toes are webbed to the end of the digits; in two middle toes the webbing it not up to the end of the digit; inner toes are half webbed. Outer aspects of the limbs bear serrated fringes. Upper jaws bear 17 to 19 sharp teeth on each side (5 in each premaxilla). Adult crocodiles are dark olive, juveniles are pale with black spots.

Distribution : Its range includes India, Bangladesh, Iran, Nepal, Pakistan and Sri Lanka. Marsh crocodile is available in scattered populations over most of India, except the state of Jammu and Kashmir, Himachal Pradesh and Punjab in the extreme north-west and the north-west desert regions. The eastern limit of distribution extends beyond the Darrang district into Arunachal Pradesh. In India *C. palustris*, still occurs in small scattered and isolated populations in many states like Kerala, Tamil Nadu, Karnataka, Andhra Pradesh, Madhya Pradesh, Maharashtra, Orissa, Gujarat, Rajasthan, Uttar Pradesh, Bihar, Haryana and West Bengal.



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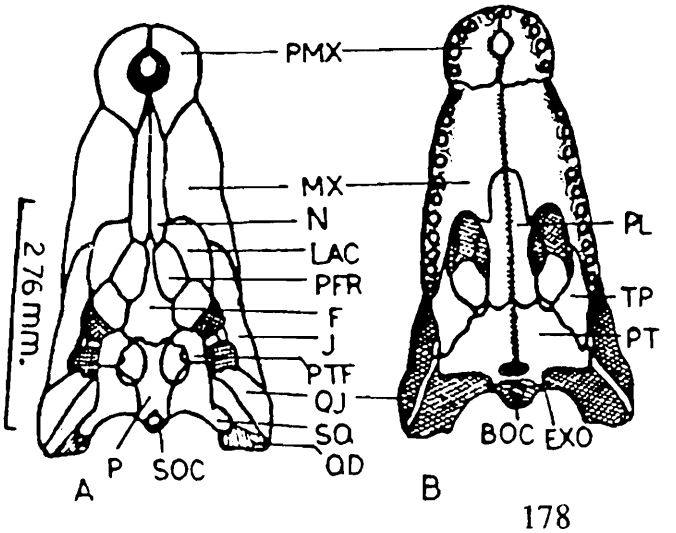

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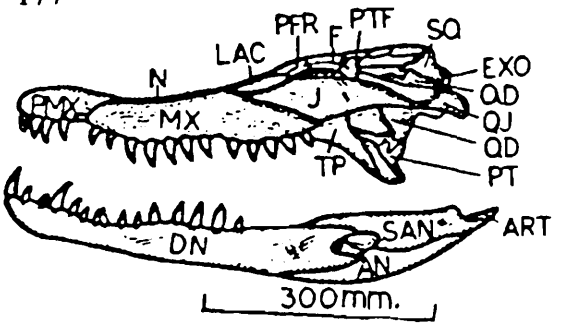

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Figs.176–179 *Crocodylus palustris* Lesson. 176. Head; 177. Skull (Dorsal); 178. Skull (Ventral); 179 Skull (Lateral).

Habits and habitat : This sluggish crocodile occurs in any kind of freshwater habitat and are occasionally reported in brackish waters well within tidal limits. Mugger prefers still waters with a depth of 3-5 m. and may be present in rivers, streams, junge pools, man-made lakes, villages ponds and large irrigation reservoirs. The species avoids fast-flowing rivers during monsoon periods and sometimes Muggers are seen in river side villages at this time of year. Burrows are excavated in the banks or inhabited waters, sometimes to a depth of 8-10 m., these may provide shelter from extremes of temperature since new burrows may be made both in summer and winter. Muggers of all sizes prefer to live in groups in their respective size class, except for males during the breeding season. Like other crocodilians Mugger is also carnivorous. Hatchlings predominantly feed on water insects and fish fingerlings. Adult crocodiles

have been reported feeding on frogs, small mammals, birds, squirrels, mongoose, kites, crows, monkeys, paddy birds, cat fish and other vertebrates. Courtship season is from November to February in India. Males exhibit a strong dominance hierarchy and dominant males mate with several females. Mating takes place in the open water. The females start digging trial nest pits at least a fortnight before actual egg laying. Netst are made inside the burrows and 10-35 eggs (4 to 5 cm. by 6 to 8 cm. weighing 80 to 120 gms.) are laid in a nest chamber of 35 to 50 cm. depth. The nest chamber is a widemouthed pitcher shaped structure, dug quite away from the water's edge in a high sloping bank. The egg laying takes place between late February to first week of April. Nest temperature vary from 30 to 34°C and incubation period varies from 50 to 65 days. Hatchlings that are ready to emerge make grunting noises from within the nest stimulating the mother crocodile to excavate the nest and release the hatchlings to the water. Hatchlings are 25 to 30 cm. in length and weigh about 60 to 100 gm.

Status : In India the main threats to survival of Mugger are; i. Set net fishing (nylon gill nets) set across rivers or standing bodies of water, usually set out in the evening and taken in the next morning when trapped crocodiles are clubbed to death. ii. Egg predation for food by human, mongooses, jackals, monitor lizards and sloth bears. iii. Hatchling predation by birds like herons and storks. iv. natural calamities like flooding and desiccation. v. Habitat destruction. vi. Medicinal use of crocodile parts and their eggs by human beings.

Population of *C. palustris* has been depleted considerably throughout the range and present population rise is estimated to be around 5,000 in India. The best remaining populations are in Tamil Nadu (400 crocodiles) and Gujarat (200 crocodiles). More than 2000 eggs a year are collected for captive hatching by different state crocodile projects in India. Collection of wild-laid eggs is carried out by the Government Wildlife conservation agencies for captive hatching and rearing for eventual release in suitable wild *C. palustris* habitat. Many states in India like Tamil Nadu, Gujarat, Orissa, Andhra Pradesh, Kerala, Uttar Pradesh, Maharashtra, Karnataka and Rajasthan are now engaged in such Mugger conservation programmes since 1975.

This species breeds readily in captivity and several zoos have been breeding Mugger since the first success at Jaipur Zoo in 1960. The various Zoos in Inda engaged in the breeding of this crocodile are Jaipur Zoo (breeding since 1960), Ahmedabad Zoo (breeding since 1967), The Madrs Snake Park and Crocodile Bank Trust (breeding since 1975), Delhi Zoo (breeding since 1976), Vizag Zoo (breeding since 1978), Hyderabad Zoo (breeding since 1980) and Baroda Zoo (recently started the breeding).

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GLOSSARY

Abdominal Scutes.— The third rearmost pair of shields of plastron.

Acetabulum.— Wide socket on the lateral aspect of pelvis for the head of femure.

Acromion.— A scapular elongation. It is directed postro-mesially in Testudines.

Alveolar.— Pertaining to the margin of the jaw where the teeth are generally situated (functional, biting part of the jaw).

Amphicoelous.— Vertebra with a socket at each end.

Anaerobic.— Without oxygen.

Anal Scutes.— Rearmost pair of shields in the plastron.

Ankylose.— To grow together into one.

Anomalous.— Irregular or abnormal.

Arcade.— A narrow bony bridge.

Aerola.— Part of the carapace of the Testudine which persists at the time of birth, and from which the new growth of shell proceeds.

Articular.— Bone of the lower jaw, forming hinge with the upper jaw.

Atlas.— The first neck vertebra.

Axillary.— Pertaining to the axilla or armpit.

Axillary notch.— The notch in the front part of the shell into which the front leg fits and from which it protrudes.

Axillary Scutes.— The small plastral scales, opposite the armpit.

Axis.— The second cervical vertebra.

Axygous.— Not one of a pair.

Basisphenoid.— A skull bone between the basiocipital and the pterygoid bones.

Beak.— The horny covering of the jaws assuming the shape of bird's beak.

Bicuspid.— Having two points or cusps.

Bifrucate.— Dividing in two branches.

Bridge.— That portion of the Shell, connecting carapace with the plastron.

Callosity.— An abnormal hardness and thickness of the skin.

Carapace.— Bony upper shied of a turtle or tortoise.

Carinate.— Having a keel.

Caruncle.— A horny tubercle on the snout of young turtles, used for breaking through the egg shell.

Caudal.— of the tail.

Centrum.— The body of the vertebra

Cervical.— Pertaining to the neck.

Choanae.— The posterior nares.

Clavicular.— Pertaining to the clavicle.

Cloaca.— Chamber into which open the anus, urinary duct and genital ducts.

Columella auris.— A delicate rod-like bone in the middle ear.

Columnar.— Vertically elongated.

Concentric.— Having a common centre.

Condyle.— An articular prominence on a bone.

Confluent.— Merging together.

Comprodaeum.— A part of the cloaca.

Coracoid.— A fan-shaped bone in the shoulder girdle connected to the scapula.

Coronoid.— Bone of the lower jaw, bearing the jaw closing muscles.

Costals.— Large side shields of the carapace.

Cretaceous.— A period about 140 million to 65 million years before the present time.

Costal.— Pertaining to the ribs.

Crenulated.— Feebly indented or crenate.

Crepuscular.— Active at twilight or preceding dawn.

Cruciform.— Cross-shaped.

Cusp.— A point.

Cyclical.— Recurring in cycles or periods.

Dentary.— A bone of lower jaw bearing the teeth or a horny sheath.

Denticulate.— Having small tooth like projections.

Dimorphism.— The occurence of two forms, distinct, either in structure of colouration or both.

Disc.— The dorsal or ventral shield.

Emerginate.— Opened in the form of a brood notch at the margin.

Endemic.— Species restricted to a particular area.

Entoplastrone.— A single antero-centrally located plastral bone occuring between and surrounded by the epiplastra and the hypoplastra.

Eocene.— A period about 55 million to 35 million years before the present time.

Epiplastron.— Anteriormost plastral bones.

Estivation.— Inactive long periods of drought or high temperatures.

Facet.— A small flat and smooth articular surface of bone.

Femoral.— Of the thigh.

Femoralis.— The penultimate scutes of the plastron.

Femur.— Thigh bone or the long bone forming the upper part of the hind leg.

Fenestra.— Opening.

Fibula.— The smaller of the two parallel bones forming the lower part of the hind leg.

Frontanella.— The space left between two or more bones; it may or may not fill up later in life.

Fossa.— A shallow depression of cavity.

Foramen.— A permanent opeining in a bone through which a structure such as a nerve or major blood vessel passes.

Frontal.— Head shield.

Frontal bone.— Bone which forms the skull roof a turtle.

Girdle.— There are two bony structures, anterior one is Pectoral or shoulder girdle, providing support tot he forelimbs; posterior one is Pelvic girdle, providing support to the hind limbs.

Glenoidfossa.— The socket in the scapula bone which receives the head of the humerus.

Gular.— Pertaining tot he throat.

Gular.— Pertaining to the throat.

Gular scutes.— Anteriormost shields of plastron.

Herbivorous.— Feeding on plant and vegetable matter.

Homologous.— Having the same relative position, corresponding.

Humeral.— Pertaining to the humerus or bone of the upper arm.

Humeral scutes.— The second pair of scutes in the turtle plastron.

Humerus.— Arm bone or the long bone which forms the upper part of the forelimb.

Hyoid.— The bony and cartilaginous structure int he floor of the mouth which supports the tongue.

Hyoplastra.— The second frontmost pair of plastral bones.

Hypoplastra.— The second rearmost pair of plastral bones.

Iliac.— pertaining to the ilium or hip bone.

Imbricate.— Overlapping like tiles on a roof.

Inframarginal scutes.—Shields present between the marginals of the carapace and

the pectoral and abdominal shields of the plastron in certain turtles.

Inguinal.— Pertaining to the groin region.

Inguinal Notch.— The notch at the rear of the bridge, from which the hind led protrudes.

Inguinal scutes.— Shields or scales situated just in front of the inguinal notch.

Intercalated.— Interposed.

Intercentrum.— A pad of cartilage or bone interposed between the centra or bodies of the vertebra.

Intergular scute.— A small scute, partially or wholly separating the gular scutes in certain species of turtles.

Internasal.— Shield between nasal shields.

Jugal.— The bone which forms the posteroventral margin of the orbit in a turtle skull.

Jurassic.— Time period about 155 million years to about 130 million years before the present time.

Juxtaposed.— Placed in opposition to not imbricate.

Keel.— Elongated ridge on scale.

Kinesis.— Fee movement between the bones or bony structures.

Labyrinth.— The cavities of the internal ear.

Lamella.— Thin plates.

Lamina.— A blade like structure or an alternative name for a shield or scute.

Lanceolate.— Tapering at the end.

Loreal.— Space between the snout and the eye.

Laterals.— Alternative name for costal shields.

Lumber.— Pertaining to loin.

Mandible.— The bone of the lower jaw.

Marginal.— Plates forming the edge of the carapace.

Marginal scutes.— The small shields around the edge of the carapace.

Maxillary grove.— A name proposed for a well marked groove in the mid-line of the palate which is found in some species of *Trionyx*.

Meekel's cartilage.— A stripe of cartilage located inside the posterior parts of the lower jaw.

Mental.— Of the chin.

Mesial.— Situated in the middle line of the body.

Mesoplastra.— Plastral bones between the hyoplastra and hypoplastra in cer-

tain turtles.

Mesozoic.— A geological era generally known as the "Age of Reptiles", approximately 185 million years to about 130 million years before the present time, encompassing the Triassic, Jurassic, and Cretaceous periods.

Miocene.— Time period about 20 million years to about 12 million years before the present time.

Monotypic.— A taxonomic category containing only one immediately sub-ordinate category, as a family with one genus or a genus with only one species.

Nares.— The nasal opening.

Nasopalatine foramen.— The opening in the upper part of the bony palate into which the nasal chambers opens.

Neural.— Pertaining to the nerves or nervous tissue.

Neural Bones.— The median row of bones in the turtle carapace.

Nodose.— Knobbed.

Nuchal.— Pertaining the neck.

Nuchal Bone.— The large bone at the front of the turtle carapace.

Nuchal Scute.— A small scute available in many turtles at the front of the carapace.

Obturator Foramen.— A large central opening in the pelvis, sometimes vertically divided.

Occipital.— Pertaining to the occiput or back part of the head.

Ocellus.— A coloured spot surrounded by a ring of different colours.

Oligocene.— Time period about 35 million years to about 20 million years before the present time.

Omnivorous.— Feeding on both animal and vegetable matter.

Opisthocoelous.— A vertebra with a posterior articular concavity.

Ossicle.— A little bone.

Oviparous.— Producing young by means of eggs which are laid.

Palatine.— Bones which participate in the formation of the anterior part of the palate of turtles, palatnies are generally separated by the vomer.

Paleocene.— Time period about 55 million years before the present time.

Papilla.— A soft, elongated protruberance.

Parietal.— Bone which participate in the formation of the posterior portion of the skull roof of a turtle.

Parocipital.— A bone at the rare of the turtle skull, which lies between the exocipital and sqamosal bones.

Pectoral.— Pertaining to the breast.

Pectoral scutes.— The third frontmost pair of plastral scutes.

Pedicle.— A thickened area of a bone formed to withstand weight or pressure.

Pentadactyle.— Having five fingers and toes.

peripheral Bones.— The bones around the edge of the turtle carapace.

Permain.— Time period about 275 million years to about 230 million years before the present time.

Phalanges.— Digit bones.

Plastral Lobe.— That part of the plastron which lies in front of the axillary notch or behind the inguinal notch.

Plastron.— Bony ventral shield of a turtle or tortise shell.

Plantar.— Pertaining to the sole of the foot.

Pleistocene.— Time period about 2 million years to about 11 thousand years before the present time.

Pleural Bone.— One of the elongated bones enclosing a rib and making up the lateral part of the shell of a turtle.

Pliocene.— Time period about 12 million years to about 2 million years before the present time.

Poikilothermous.— Animals in which the body temperature varies with the temperature of the environment.

Polytypic.— A term used to describe a taxonomic category containing more than one immediately subordinate cagtegory.

Postfrontal.— A bone which makes up the upper part of the orbit in the turtle skull.

Postorbital.— A scale or other structure behind the eye.

Postzygapophysis.— One of two small projections extending from the rear ofa vertebra, which make sliding contact with the prezygapophysis of the adjacent vertebra to the rare.

Precentral.— Alternative name for the nuchal shield.

Precostal Scute.— A shield preceding the costal scutes, in extinct turtles.

Prefrontal.— Head shield preceding frontal shield.

Premaxilla or Premaxillae.— Skull bones which extend from the nasal opening to the anterior part of the orbit.

Preocular.— In front of eye.

Procoelous.— Vertebrae with the anterior end of the centrum or body concave.

Proneural.— Alternative name for the nuchal bone.

Pterygoid.— A median bone which forms the rear portion of the palate of a turtle.

Pygal.— The rearmost median bone in the carapace of turtle.

Quadrate.— A skull bone providing a joining surface for the lower jaw.

Radius.— One of the tow bones making up the fore arm.

Ramus.— One branch or lateral extension of a symmetrical or branched structure.

Reticulate.— Arranged like a net.

Reticulations.— A network of intercrossed lines.

Reverted.— Turned back.

Rostral.— Of the snout.

Sacral.— Pertaining to the sacrum.

Scapula.— A bone in the Pectoral girdle, which articulates with the humerus.

Scutes.— Scales or plates.

Secondary Plate.— A posterior extension of the alveolar surfaces of certain turtles.

Septum.— A thin, cartilaginous plate separating two structures or vacuities.

Serrated.— Notched or toothed on the edge, like a saw.

Sigmoid.— Taking a shape like the letter S.

Splenial.— A bone situated on the inside edge of the lower jaw, toward the rear.

Squamosal.— A bone located above the ear region of a turtle.

Stapes.— The columella of the auditory chain.

Sub.— Somewhat; slightly.

Supracaudal.— Above the tail.

Supracaudal Scutes.— Rearmost marginal scutes.

Supranasal.— Above the nostril.

Supraoccipital.— The bone forming the roof of the foramen magnum.

Surangular.— A bone located near the rear of each raums of the lower jaw.

Suture.— A jagged connection between two bones.

Sympatric.— Occupying the same geographic area.

Symphysis.— The union of two bones in the median plane of the body, such as the two halves of the lower jaw.

Synonym.— One of the several names which apply to the same taxonomic entity, only one of which is valid. Invalid names are called synonyms.

Tectiform.— Roof-like.

Temporal.— Pertaining to the temple.

Tertiary.— Time a period about 65 million yars to about 2 million years before the present time, encompassing paleocene to Pliocene epochs.

Tibia.— The thicker of the two parallel bones forming the lower part of the hind legs.

Timpanic.— Pertaining to the tympanum or middle ear.

Tricarinate.— With three longitudinal ridges or keels.

Tricuspid.— Having three cusps or points.

Triturating.— The functional surface of the jaw.

Truncate.— Cut short.

Tubercle.— A small lump or knot like outgrowth.

Tuberosity.— A large tubercle or outgrowth.

Tympanum.— The vibrating surface which forms the external ear in turtles.

Type.— The specimen on which species is based and named.

Type Genus.— The genus selected as a standard of reference for a family.

Type Locality.— The spot from which the type specimen or specimens of a species were collected.

Type Species.— The species upon which the description of a genus is based. If a genus is later split into several genera, the type species has to remain with the original generic designation.

Typical Subspecies.— That subspecies which bears the same name as the species.

Ulna.— A bone in the fore arm which runs parallel to the radius.

Vacuity.— A space.

Vermiculate.— Marked with wavy impressions, like worm-tracks.

Vertebral.— Pertaining to the vertebrae or backbone.

Vertebral Scutes.— Alternative name for central scutes.

Vomer.— An elongated median bone present in the palate of turtles.

Wallace's Line.— The imaginary boundary separating Asiatic and Australian fauna, it passed between Bali and Lombok and between Borneo and Celebes, east of Philippines.

Xiphiplastra.— The rearmost pair of plastral bones.

Zygapophysis.— The articular process of vertebra

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